

**Assessment of the sheep production management systems of
small-scale farmers in the Maluti-a-Phofung Local Municipality of
the Eastern Free State**

by

Mahlako Richard Sankatane

Research thesis submitted in fulfilment of the requirements
of the degree

M.Tech: Agriculture

**Department of Agriculture
Faculty of Health and Environmental Sciences
Central University of Technology, Free State**

Supervisor: Prof. P.J. Fourie

Co-supervisor: Prof. C. van der Westhuizen

AUGUST 2018

TABLE OF CONTENTS

LIST OF FIGURES	iii
LIST OF TABLES.....	iii
LIST OF ABBREVIATIONS.....	iv
DECLARATION	v
ACKNOWLEDGEMENTS	vi
ABSTRACT.....	vii
 CHAPTER ONE: INTRODUCTION.....	 1
1.1 Background.....	1
1.2 Problem statement.....	2
1.3 Objective of the study	3
1.4 Justification for the research	3
1.5 Hypotheses.....	3
1.6 Hypothetical solutions	4
 CHAPTER TWO: LITERATURE REVIEW.....	 5
2.1 Demography of the Thabo Mofutsanyana District Municipality	5
2.2 Sheep management systems.....	6
2.3 Contribution of sheep production to the prosperity of South Africa	7
2.4 Small-scale farmers	8
2.5 General constraints facing small-scale farmers.....	10
2.6 Key elements in management skills	11
2.6.1 Preparation of rams	12
2.6.2 Preparation of ewes for mating	13
2.6.3 Breeding management.....	14
2.6.4 Breed selection	14
2.6.5 Breeding methods.....	15
2.6.6 Reproduction and production	15
2.6.7 The impact of climate change on agricultural productivity	16
2.6.8 Weaning.....	17
2.6.9 Nutrition and management.....	17
2.6.10 Grazing management.....	19
2.6.11 Animal health	21
2.6.12 Record keeping.....	21
2.6.13 Handling and transportation of animals	22

2.6.14 Meat production	23
2.6.15 Marketing	24
CHAPTER THREE: RESEARCH METHODOLOGY.....	29
3.1 Introduction.....	29
3.2 Study area	29
3.3 Data collection	31
3.4 Data analysis	32
3.5 Technology transfer / application of results	32
3.6 Industrial/community relevance	33
3.7 Ethical considerations.....	33
CHAPTER FOUR: RESULTS AND DISCUSSION	34
4.1 Introduction	34
4.2 Demographics.....	34
4.3 The management challenges encountered by small-scale sheep production farmers in the study area	37
4.3.1 Farming experience	37
4.3.2 Health management.....	38
4.3.3 Marketing skills and challenges.....	39
4.3.4 Farming equipment owned by farmers	41
4.4 Constraints experienced in sheep production systems by small-scale farmers	42
4.4.1 Reproduction and production management.....	42
4.4.2 Nutritional management	44
4.4.3 Support services	45
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS	47
5.1 Conclusion	47
5.2 Recommendations	48
5.3 Extension implications	48
REFERENCES	50
ANNEXURES	60
Annexure A: Questionnaire.....	60
Annexure B: Article submitted to SA Journal of Agricultural Extension	71

LIST OF FIGURES

Figure 1:	Number of households engaged in agricultural activities	6
Figure 2:	The area of study in the Eastern Free State (Maluti-a-Phofung Local Municipality)	29
Figure 3:	Age of the respondents	35
Figure 4:	Educational status of the respondents	36
Figure 5:	Farming experience of the study group	38
Figure 6:	Mating practice	43

LIST OF TABLES

Table 1:	Agricultural household farming statistics for the Thabo Mofutsanyana District Municipality	30
Table 2:	Preferred type of marketing	40
Table 3:	Preferred transportation to the market	41
Table 4:	Essential farming equipment	41
Table 5:	Lambing percentage per location	42
Table 6:	Fertility tests versus number of lambs born alive in the previous lambing season	43
Table 7:	Different sheep breeds of study group	44
Table 8:	Number of respondents using supplementary feeding during and after pregnancy	45
Table 9:	Source of information and support	46

LIST OF ABBREVIATIONS

DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DoA	Department of Agriculture
FAO	Food and Agricultural Organization
GDP	Gross domestic product
GGP	Gross geographic product
IPCC	Intergovernmental Panel on Climate Change
IPMS	Improving Productivity and Market Success
LTSSG	Land Transport of Sheep Standards and Guidelines
NWGA	National Wool Growers Association
RPO	Red Meat Producers Organization
RVF	Rift Valley fever
SAMM	South African Meat Merino
SAWAMBA	South African Wool and Mohair Buyers Association
SPSS	Statistical Package for the Social Sciences
Stats SA	Statistics South Africa
UN	United Nations

DECLARATION

I, Mahlako Richard Sankatane, declare that this research thesis is my own work, that it has not been submitted for any degree or examination at this or any other university or tertiary institution, and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

Signed: _____

Date: _____

ACKNOWLEDGEMENTS

Financial assistance from the Central University of Technology, Free State, is gratefully acknowledged. The technical assistance of Distinguished Professor P. Fourie is highly appreciated.

ABSTRACT

The purpose of this project was to evaluate small-scale farmers' management of sheep production systems in the Eastern Free State. Primary data were collected from 40 small-scale farmers using questionnaires in the study area and the results were analysed using a descriptive analysis model. The results indicate that the majority of the respondents (35 or 87.5%) were male, and five (12.5%) were female. This indicates the general farming demographics of the regions. The results also showed that only 32.5% had a tertiary education. Parameter estimates are indicated from low education levels and a lack of farming skills pertaining to livestock production (with only 42.5% of the farmers having adequate skill levels); poor management skills in terms of nutritional and health management (only 57.5% supplied supplemented feeding prior to lambing); high transportation costs (48% of farmers did not own transportation to the market); lack of market information (66% of the farmers actively marketed their product); and poor delivery of support services from the government as only 45% of farmers surveyed received support services from government. It was also evident that the majority of the farmers did not have the most basic equipment i.e. dosing gun, syringe and castration equipment. The findings also showed that 34% of the respondents suffered from a lack of market information owing to poor communication, tools, and support services from the government and extension officers. The majority of the farmers relied on word of mouth, family, and own research for information regarding product prices, which in most cases was biased, inaccurate, and/or out-dated. The study recommends that the government must host planned workshops for all farmers in order to equip them with knowledge. Short courses should be provided to small-scale farmers, furthermore, support must be provided through training activities, and business counselling must be given to the farmers and farm managers in the Eastern Free State.

CHAPTER ONE

INTRODUCTION

1.1 Background

The first sheep in South Africa are said to have originated in South and Central Asia, from where they migrated to Egypt and then down through Africa, eventually arriving in the Cape. The sheep seen by visitors to the Cape were very big, had big tails similar to the sheep found in Syria, and also had very good meat. They were different from other sheep in that they did not have wool but rather hair. From the early 19th century, sheep farming expanded throughout South Africa with the occasional decline in sheep populations due to the invasions by the British into South Africa and the subsequent Anglo Boer War. During this period, a number of new breeds such as the Dormer and Merinos were introduced in the market by Anglo Boer (Hofmeyr, 1976). Today, the main concentration of Merinos is found in the Karoo (Somerset East, Cradock, Graaff-Reinet, Murraysburg, and Richmond). Merino sheep are found in almost every district of South Africa, including the drier Northern Cape province, together with other breeds such as Dorper, Dormer, and Dorset Horn. Both small emerging farmers and stud breeders farm with these different breeds. Furthermore, on the fertile lands of the winter rainfall areas of the Western Cape province, millions of Merino sheep run on the Karooveld and grassveld. Well-known Merino breeders with large, top-quality flocks are also found in the East Griqualand area of KwaZulu-Natal and most parts of Mpumalanga, and with the growth of the number of wool-bearing sheep, it was eventually necessary to establish the Wool Commission to oversee South Africa's wool industry, according to Poggenpoel and Van der Merwe (1987).

The Merino's production potential for fine wool is unique. Under the leadership and guidance of the Wool Commission, South Africa is the fifth largest wool producer in the world today. The contribution of wool to the South African economy is second only to the gold mines (African Development Bank, 2015). The sheep breed with the highest wool production per head in South Africa is the pure-breed Merino. The other dual-purpose Merino strains that are very popular are the Dohne Merino, the South African Mutton Merino (SAMM), and the Letelle. Annual wool production in South Africa is currently about 45 000 tonnes (National Wool Growers Association (NWGA), 2012). Communal and emerging wool farmers produce 12% of the national clip and are mainly located in the communal areas of the Eastern Cape and KwaZulu-Natal, as well as in the Thaba Nchu and QwaQwa areas (Free State). Sheep numbers in South Africa are estimated at 24.6 million distributed in all nine provinces. Approximately 29% of the sheep are in Eastern Cape followed by Northern Cape with 25%, Free State by 20% and Western Cape by 12%. These four Provinces constitute 86% and the

other five Provinces share 14% of the country's sheep (DAFF, 2012). Sheep farming is predominantly farmed in the western and southern regions of the Free State, in which Maluti a Phofung as a study area is within the southern region and have farmers farming with different sheep breeds (DAFF, 2012). In the Eastern Free State, small-scale farmers have been observing a long-standing problem of poor sheep production without solution and some farmers do not even realise that they have a problem. It will be more cost effective if the source of the problem is identified and solutions are obtained, even though some may argue that it is the result of nature and not poor management.

1.2 Problem statement

In South Africa, small-scale farmers are confronted with many constraints that hinder them from contributing to the economy. Poor management skills are one of the biggest hindrances to these farmers. These poor management skills are based on inadequate knowledge and lack of information. Over the years, rural farmers have depended on indigenous or local knowledge for improved farming systems and animal husbandry (Obidike, 2011). Such knowledge (indigenous or local knowledge) refers to skills and experience gained through oral tradition and practice over many generations. The acquisition of such primitive skills by the rural farmers (e.g. Eastern Free State small-scale farmers) has not helped to improve agricultural yield (Obidike, 2011).

According to the literature, problems in rural agricultural systems range from poor farm yield, emergence of new crops and animal diseases, resistant plant weeds and pests that attack farm crops, old farm implements, poor-quality fertilisers, etc. Agricultural information is meant to reach rural farmers via extension workers, community libraries, radio, television, films, agricultural pamphlets, and state and local government agricultural agencies (Nnenna & Obadike, 2011). Rural farmers are confronted with certain constraints with regard to improving their knowledge to be able to improve production yield, such as a lack of access to information (Aina, 2007). The present study is therefore designed to identify the constraints that hinder small-scale farmers in the Eastern Free State from practising better animal husbandry techniques.

Poor sheep management practices negatively impact the production of emerging farmers in the Eastern Free State due to different aspects that can be supplemented or eliminated, such as indigenous knowledge and resistance to adopt new technology and management skills. Poor management results in less reward or no rewards at all, which causes these farmers to incur financial losses. A literature review revealed that there are no documented studies in the Eastern Free State in the Maluti-a-Phofung Local Municipality and neighbouring municipalities

based on sheep management by small-scale farmers. Therefore, this research intends to uncover the problems encountered by the farmers in this area that result in poor management practices while possible solutions to improve the situation will also be suggested to these farmers.

1.3 Objective of the study

The broad objective of this study is to identify problems in the management of sheep production in the Eastern Free State encountered by small-scale farmers. The sub-objectives are:

- To determine the main management systems used by small-scale sheep farmers in the Maluti-a-Phofung Local Municipality located in the Eastern Free State;
- to determine constraints experienced in sheep production systems by these small-scale farmers; and
- to emphasise the possible role agricultural extension can play in the improvement of management practices.

1.4 Justification for the research

Small-scale farmers are confronted with many constraints that hinder them from contributing to the economy. The purpose of the research is to identify problems in the management of sheep production and to recommend possible solutions that will resolve long-standing problems, focusing on emerging small farmers in the Eastern Free State. This research will assist in poverty alleviation and contribute to the economy of the Eastern Free State and South Africa as a whole and assist in the education of emerging small-scale farmers for improved management of sheep in future. It will also assist authorities (extension officers, etc.) on challenges experienced by small-scale farmers and what can be done to mitigate these challenges. This may promote sustainability in the long run.

1.5 Hypotheses

The management skills of small-scale farmers in terms of sheep production systems are mostly believed to be inadequate. The current status of sheep production farming (among emerging farmers) in the Eastern Free State is poor due to the poor management practises and skills of the farmers, resulting in sub-optimal production. Skills and knowledge constraints hamper proper management systems, resulting in low production and reproduction rates, thus causing poverty.

1.6 Hypothetical solutions

Identified challenges facing sheep producers will assist government authorities and interested parties to draft and develop mitigation measures for such challenges, and also to be aware of what kind of management skills these farmers require in order to practice better management. The solutions obtained from the research will be used to improve the general management of farmers and planning to take into account the risks, issues, and financial and other constraints of the farmers.

CHAPTER TWO

LITERATURE REVIEW

2.1 Demography of the Thabo Mofutsanyana District Municipality

The Free State province, best known as the food basket of South Africa, has since 1989 changed from being dependent on mining and agriculture to a manufacturing, export-orientated economy. The population is estimated at 2.9 million, of which 51% are women and 49% are men; and youths comprise 30% of the population. The unemployment rate is 38.9%. The Thabo Mofutsanyana District Municipality, which includes the former QwaQwa homeland, is one of the poorest parts of the country, with the highest unemployment rate and poorest per capita gross geographic product (GGP) in the province. However, the district, known for its fruit and grain farming, holds opportunities for growth and development, especially in the area of food security (Government Communications South Africa, 2012). Agricultural statistics are key to the measurement of the performance of the agricultural sector.

Poor rural households are constantly in a struggle to make ends meet regarding food security and family livelihood expenses constituting some of the major priorities of these households (Van Rooyen, 2008). Globally, agriculture provides a livelihood for more people than any other industry and, thus, since most of the world's poor live in rural areas and are largely dependent on agriculture, it plays a role in reducing the poverty in these rural areas.

The Thabo Mofutsanyana district has many emerging agricultural farmers and contributes to the local and national economy with many households practising backyard farming to improve food security and access to food. Research released by Statistics South Africa (Stats SA) in 2011 indicated the number of households engaged in agricultural activities to assist them to survive in the respective provinces. Figure 1 indicates the number of households engaged in agricultural activities in the respective provinces.

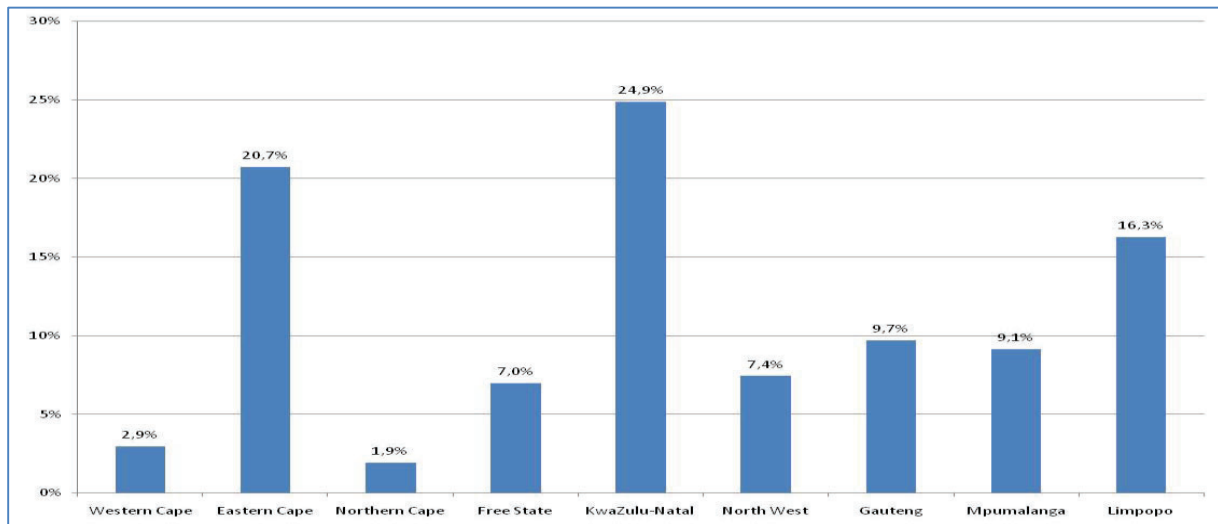


Figure 1: Number of households engaged in agricultural activities

Source: Stats SA (2011)

Figure 1 indicates that the third lowest percentage of agricultural households engaged in agricultural activities was recorded in the Free State (7.0%), followed by the Northern Cape (1.9%), and Western Cape (2.9%).

2.2 Sheep management systems

They are two major sheep farming management systems that are used throughout the world for sheep production, namely extensive production for wool and meat, and traditional pastoralism (Kilgour *et al.*, 2008). Production systems for sheep production vary from extensive free ranging to controlled grazing or zero grazing feedlots. The type of system in use depends on the environment, product, the degree of control required, and the preferred management programme (Maree & Casey, 1993). The extensive management systems for sheep production are the most common in all sheep-producing countries, and extend from lowland farming systems, where relatively small flocks graze fenced enclosures, to rangeland management systems, where large flocks live on unfenced pastures. Flock size, the ratio of sheep to shepherds, and specific management practices follow local norms (Kilgour *et al.*, 2008).

Maree and Casey (1993) indicate that the extensive grazing system is mostly used in areas of low rainfall with sparse vegetation of xerophytic and succulent shrubs with mainly annual grasses, most of which are palatable with high nutritional values with large diurnal and seasonal temperatures, but in more moderate climatic areas, sheep and goats are grazed either separately or combination with cattle, since each species grazes or forages a different spectrum of herbage.

In the semi-intensive system, the flock consists of dual-purpose sheep or wool-type breeding ewes running on the veld with feed supplements or crop residues. With dual-purpose sheep, all lambs are sold in February and none are retained as wethers; however, on wool-type ewes they are mated in spring and lambs are put on pastures in winter and sold off the veld in February. Furthermore, the proportion of the flock consists of wethers running on veld for wool production (Smith, 2006).

The intensive grazing system provides dry matter needed for animal production. However, it holds the potential to improve production dramatically, even to the extent of 50% in total animal live weight per hectare and it is mainly possible in areas of good rainfall (Maree & Casey, 1993). In addition, Smith (2006) states that an intensive grazing system is good for fat lamb production on pastures, with ewes mated in spring and re-mated in autumn.

In intensive sheep production systems, ewes are most likely synchronised, lambs more frequently than once a year, and probably in lambing pens with multiples. This is done to increase production and profitability per hectare on smaller farms. These systems have their challenges and increased cost structures and it is important to be aware of the issues surrounding them. The feeding of animals in these systems is much more critical than in an extensive system and must be properly managed to prevent unlimited expenses, while the animals need to be fed the correct feed according to their increased needs (Kilgour *et al.*, 2008).

2.3 Contribution of sheep production to the prosperity of South Africa

The South African government, through the livestock development strategy, is working to end poverty and food insecurity in the country by enhancing the productivity of smallholder livestock farmers. Expanding the livestock industry will lead to employment, improved income and socio-economic development in the country, and particularly in rural areas where livestock production dominates (Department of Agriculture, Forestry and Fisheries (DAFF), 2014). Most (69%) of South Africa's land surface is suitable for grazing, and livestock farming is by far the largest agricultural sector in the country (Goldblatt, 2013). Livestock are also found in other areas where they are kept in combination with other farming enterprises. Sheep and goat farming occupy approximately 590 000 km² of land in South Africa. This represents 53% of all agricultural land in the country. This includes the vast Karoo areas of the Northern and Western Cape provinces and the mixed veld types of the Eastern Cape and Southern Free State. Commercial sheep farms are also found in other areas such as the Kalahari, the winter rainfall areas, and the grasslands of Mpumalanga, Eastern Free State, and KwaZulu-Natal, where other farming types, such as cattle farming, are also practised.

The livestock sector in developing countries contributes more than 33% to the agricultural gross domestic product (GDP) and is also one of the fastest growing agricultural subsectors, a major contributor to food and nutrition security, as well as serving as an important source of livelihood for nearly 1 billion poor people in developing countries (Swanepoel & Moyo, 2010). In addition, it is anticipated that the livestock sector will become the world's most significant agricultural subsector in terms of value add and land use (Van der Zijpp, Wilke & Carsan, 2010).

Livestock can be described as all domesticated animals – especially sheep, goats, cattle, and pigs – intentionally reared in an agricultural setting for food, fibre, or breeding purposes (Ntshepe, 2011). Livestock systems occupy about 30% of the planet's dry land surface area (Steinfeld *et al.*, 2006). South Africa has a dual agricultural economy – with both well-developed commercial farming and more subsistence-based production in the deep rural areas – which plays a role in poverty alleviation. Primary agriculture contributes about 3% to South Africa's GDP and about 7% to formal employment. However, there are strong linkages to the economy, with the agro-industrial sector comprising an estimated 12% of the GDP (Government Communications South Africa, 2012).

In the Eastern Free State, agriculture plays a major role in sustainable rural development in which crop production and livestock farming are used as a source of food security. Livestock are kept in other areas, usually in combination with other farming enterprises. Stockbreeders concentrate mainly on developing breeds that are well adapted to diverse weather and environmental conditions. Many stockbreeders in households engaged in agriculture are farming on communal land and according to (Stats SA, 2016), the Free State has 38% of combination of animals that are produced in households engaged in agriculture.

2.4 Small-scale farmers

Small-scale or smallholder agriculture in Africa has characteristic features that distinguish it from large-scale agriculture. In general, smallholder agriculture, which is not homogeneous, is a low-input and low-output system with wide social dimensions impacting positively or negatively on productivity. However, small-scale agriculture is the linchpin of rural development in many African communities (Makapela, 2009).

In South Africa, the agricultural system has always been dual in nature with two sectors existing along parallel lines, i.e. the small-scale farming sector on the one hand and the commercial farming sector on the other. The small-scale farming sector comprises small farms that use traditional production techniques that are labour-intensive and lack institutional

capacity and support; whereas commercial agriculture is inclusive of farms that have relatively high turnovers and use modern production techniques that are capital intensive and have links with key input and output markets (Greenberg, 2010).

Inherent in that dualism is a tacit realisation that the small-scale sector is dominated by black farmers, while the commercial sector is comprised mainly of white farmers. In that context the current government has taken a conscious decision to develop the small-scale sector to a more commercialised and sustainable level. It is therefore not surprising that during the decade following the democratisation of South Africa in 1994, agricultural policy has aimed to create a new unified agricultural economy (Raphela, 2014).

In South Africa, agricultural production has primarily been dominated by commercial farms. There are approximately 50 000 large-scale commercial farmers in South Africa who are predominantly drawn from the white population. They employ about one million workers, which is 11% of the total formal sector employment in the country (Stats SA, 2011). Many of these workers live on commercial farms and their children receive education in farm schools. These commercial farms provide livelihoods and housing to about six million family members of these one million employees and provide for their education needs.

Small-scale farmers in South Africa have been subjected to years of official neglect, despite numerous policies and programmes that proclaim the opposite. In particular, dismantling Bantustan agricultural development corporations (for all their faults) in the 1990s left a vacuum in production and marketing support for the now-estimated 200 000 commercially oriented smallholder farmers and 2.5 million households practising agriculture mainly for subsistence purposes, which is believed to still be the case (Aliber & Hall, 2010a).

Small-scale agriculture is the production of livestock on a small piece of land without using advanced and expensive technologies. Although the definition of the size of these farms is a source of debate, it can be argued that farming on family pieces of land, on traditional lands, and smallholdings on the periphery of urban areas fall in this category. This type of farming is usually characterised by intensive labour and, in most cases, by animal traction, limited use of agrochemicals, and supply to the local or surrounding markets. Unlike large-scale commercial agriculture, it plays a dual role of being a source of household food security as well as a source of income from the sale of surplus. Some claim that small-scale agriculture is less efficient in output compared to commercial agriculture (Kirsten & Van Zyl, 1998).

Smallholder livestock keepers tend not to purchase production inputs and the majority of these inputs come from the farm itself or from local grazing land as part of a closed nutrient cycle. These smallholder livestock keepers operate at the lower end of the production curve, where

small additional inputs lead to substantial increases in productivity (Food and Agricultural Organization (FAO, 2009a).

2.5 General constraints facing small-scale farmers

This section discusses constraints encountered by small-scale farmers that result in poor sheep management. Inadequate and poor-quality feed resources (especially during the dry seasons) are the most serious constraint to sheep production (Nordblom & Shomo, 1995). The shortage of drinking water is another major constraint to sheep production, while poor management and poor husbandry are common in both production systems and are a result of several factors. Sheep produced under mobility are less fertile, less prolific, and are constrained by higher lamb mortality compared to sheep raised under agro-pastoral or semi-intensive systems. Poor interaction between researchers, farmers, extension workers, and policymakers is a major obstacle to improved sheep productivity in the region (Aliber & Hall, 2010a).

According to the Development Bank of Southern Africa (DBSA, 1986), common constraints facing smallholder farmers in less-developed areas may be classified into two groups, namely external and internal constraints. External constraints emanate from the broader agricultural environment and are largely beyond the control of the individual farmer. These include risks typical to agricultural activity; namely limited availability of inputs, credit, mechanisation, and marketing services; poor institutional and infrastructural support; inappropriate policies and legislation; restrictive administrative and social structures; and problems associated with land tenure and the acquisition of agricultural resources. Internal constraints are those that affect the farmer's ability to operate efficiently; despite any innate potential, the farmer might have to allocate resources in an economically efficient manner. Normally, the farmer has some control over these constraints. These include liquidity problems; shortage of workers; lack of skills, knowledge, and education; and a range of cultural factors that in some instances prevent more effective management of resources. The removal of these constraints will assist the farmer in allocating resources in an economically optimal manner. The challenge for small-scale farmers is the issue of deprivation of acquiring new skills and knowledge to respond to their ever-evolving circumstances. The area of land they cultivate is relatively small and they farm lands that are far from roads and extension services (Afenyo, 2013).

Animal diseases constitute one of the principal constraints to smallholder livestock production in the developing world. High incidences of diseases may dramatically reduce productivity, while the risk of disease restricts both further investment and intensification in livestock production. Smallholder livestock keepers fail to manage livestock diseases effectively either

because existing disease control technologies are not appropriately designed, have not been made available, or because the appropriate technologies have yet to be developed. Epidemic and endemic diseases continue to represent major constraints to livestock productivity in large parts of the developing world in the tropical regions (Munyai, 2012).

Delgado and Siamwalla (1997) argue that some of the challenges facing African smallholders are a lack of markets, high transaction costs, and poor production (Louw, Chikazunga, Jordan & Bienabe, 2007). Poor technological skills can be a serious obstacle to accessing useful formal institutions that disseminate technological knowledge (World Bank, 2008). High transaction costs also result from information inefficiencies and institutional problems such as the absence of formal markets (Makhura, 2001). Smallholder farmers in South Africa face various challenges that impede their growth and their ability to effectively contribute to food security relative to the commercial farmers. Some of the constraints they face relate to a lack of access to land, and poor physical and institutional infrastructure. Most smallholder farmers are located in rural areas and mostly in the former homelands where the lack of both physical and institutional infrastructure limits their expansion potential (DAFF, 2012). According to Afenyo (2013), poor performance of small-scale farming and the lack of improvement in farmers' situations are the result of the support they have received, and continuing to receive it does not address the totality of their needs. For instance, farmers have been supported with productive inputs and technology, with infrastructural support, with credit and market information, or with support with processing and storage. All these projects and programmes, however, may be scattered in different geographic locations in any one country at a point in time, totally de-linked from each other and thus denying farmers the synergies that different levels of support could offer. The lack of continuity in the chain of support, with production level support being subsequently complemented with support with processing and then with marketing, has contributed to denying small farmers the benefits they should derive from their farming activities.

2.6 Key elements in management skills

In an organisation, effective management is very important for the business to prosper. Cronjé *et al.* (1997) indicated that management is necessary to steer an organisation to achieve objectives. Without the input of a manager, the resources of the enterprise will not be directed towards achieving balanced operations in the organisation. In the micro environment of the organisation, a balance should exist between the objectives of the organisation and the resources available to achieve these objectives, the personal goals of employees, and the interest of the owners. It is important for management to achieve the goals of synergy and the

highest possible production. Management strives to use the lowest possible inputs from production material to achieve the highest possible outputs through available programmes.

According to Makapela (2009), flock management relates to factors such as feeding, sickness and parasite control, breeding and breeding methods, as well as the handling of animals. Flock management practices determine how the genetic potential of a flock is realised. Good knowledge of grazing, feeding, and animal production is of cardinal importance.

Small-scale farmers tend to differ in the size of their flocks. Small flocks, from 10 to 50 ewes, often are not profitable because they tend to be poorly managed. The primary reason is that mechanisation is not feasible, so return per hour of labour is not maximised. Small farm flocks are generally used simply to control weeds on irrigation ditches or maintained as a hobby (Smith, 2004).

Management means to lead and to have control over something going in a particular direction. Any organisation consists of people and resources striving for specific objectives. The people, equipment, and expertise in the organisation are important elements required to enable and steer the resources and activities to achieve the objectives. Without management, focus-orientated actions are not possible (Makapela, 2009). In order for small-scale farmers to be lucrative, management skills must be in place. These management skills comprise the key elements discussed in the following sections.

The agricultural sector can be realised by ascertaining the specific constraints to its development with emphasis on institutional, technical, and entrepreneurial factors in particular. Understanding the technical constraints affecting smallholder farmers in South Africa remains one of the critical areas for providing a sound basis for investment in order for agriculture to realise its full potential as a vehicle for poverty reduction and enhancement of the standard of living for the poor South African people (Raphela, 2014).

Some of the key management activities in the production of sheep will briefly be discussed in the following paragraphs.

2.6.1 Preparation of rams

Ringling:

Before the breeding season starts, the wool should be completely removed from all over the body of the ram. He should at least be clipped from the neck and from the belly, particularly at the region of the penis. The process is referred to as ringling. The process makes proper mating easier for the ram.

Marking the ram:

For identification purposes of ewes, which are bred by rams, it is essential that rams have on their brisket, which at the time of mating will mark the ewe at the rump, a marking. For paint either lampblack or Venetian red is used, mixed with linseed oil to make a paste, which is then applied to the brisket area at least once a week. During the course of breeding the ewe will be marked on the rump (Khanvilkar, *et al.*, 2009).

Rams need to have good feet and also be in very good bodily condition so that they can afford to lose weight during the busy mating season. However, more importantly is the fertility of the ram. Rams must be tested for fertility at least once a year but preferably more frequently. The testes should be examined during every test in order to check for abnormalities. Rams play a vital role in the intensive production system as one ram is responsible for all the ewes it is paired with. Any problems with the rams will have major consequences for the whole system. It is also preferable to have two groups of rams, with one group covering ewes every second month. This is preferable as the formation of sperm takes six weeks and an overworked ram does not bode well in the long run. The rams must also be fit in order to achieve the best results. If rams are not getting along with one another, it is best to separate them and avoid any injuries (Gebremedhin *et al.*, 2007).

Infections that increase the ram's body temperature in the two-month period up to mating can render the ram infertile. For this reason, it is a good idea to have the ram flock assembled in one point at least two months prior to mating so that any potential problems are identified in time and if required, replacement rams can be used (Moran, 2014).

2.6.2 Preparation of ewes for mating

Ewes should be in a good condition and on what is called a "rising plane of nutrition" prior to and during breeding. Too fat is not good, and too thin is not good either. If the ewes are working hard to feed twins, it is important to wean them in time to put some weight back on in time for breeding. They should be in body condition score 2.5 to 3 when the rams go with them, and continue on reasonably good feed for at least a month after. After that the farmer is essentially feeding the ewe and a lamb or two inside, therefore it is not advised to cut back too much on feed quality. The ewes should be managed through gestation and closer to lambing (Moran, 2014).

For the management of this aspect, every sheep on the farm must have a clear and permanent number. As ewes sometimes run in one large flock, the permanent numbering system is important in order to distinguish between individual ewes. When the lambs are weaned from

the ewes, the ewes are dry and they have to get into the necessary condition in order to be synchronised again within four weeks. It is now important to examine the ewes and check their udders, teeth, and hooves. This is done to ensure that they are in an ideal condition and status for the next mating. If decided on and if the weather allows it, ewes can also be sheared at this stage (Wessels, 2011).

2.6.3 Breeding management

Breeding management consists of selecting breeding animals, mating control, the removal of unwanted animals from the herd through culling or selling, and decisions as to how many animals are needed to cover all the females. The FAO (2009b) reported that poor farmers do not have the same concept of an ideal animal as exists in formal breeding societies. Instead, they seek to maintain an optimal herd composed of different lineages representing continuous functional traits and as many as possible animals, regardless of quality. However, breeding goals are more concerned with adaptive traits than with productive traits and, in most instances, breeding goals are guided by aesthetic preferences, religious requirements, and behavioural characteristics such as good nature, good mothering ability, herd ability to walk long distances, and loyalty to the owner (Munyai, 2012).

Breeding improvements are determined by genetic factors and can be controlled by making use of good rams, selecting ewe lambs that are genetically better than their mothers for future breeding purposes, the culling of unproductive and uneconomical producers, and the correct application of general breeding practices (Makapela, 2009). If the principles are applied correctly, the average quality of meat and wool production, as well as the reproduction results of the flock, will be increased (Makapela, 2009).

2.6.4 Breed selection

A farmer selects breeds to improve economically important traits, such as growth rate and wool quality. In the present commercial environment, the need for selective breeding decisions is as important as ever. It is, however, not possible to select for several characteristics at the same time. Farmers must therefore choose a specific characteristic and select the animals accordingly. The animals that do not display this characteristic must be culled and slaughtered or sold. Sheep producers can only maintain their businesses by producing lambs that meet market specifications, in terms of carcass weight, fat class, and conformation. Allied to this is the need to monitor production costs to ensure lambs are produced efficiently, and ensure the flock will generate a positive financial return (Hybu Cig Cymru Meat Promotion Wales, 2004).

During selection of breeds, knowledge of the breed and the area in which the farming activities will take place is very important. According to Sachse (2012), the most appropriate sheep breed depends on environmental conditions; the producer's desired management intensity, and personal preference. It is evident that Merino breeds adapt well in the Eastern Free State. As most farmers farm with them for accelerated sheep production, it might be necessary to use three or more breeds to develop an ewe flock that exhibits acceptable levels of desirable traits. Accelerated flocks must be able to lamb out of season, produce large lamb crops, reach sexual maturity at an early age, and grow rapidly (Thompson, 2006).

The selection of good breeding animals is vital for a successful sheep production enterprise. Selection of superior breeding animals is the basis of sheep improvement programmes. Only through superior animal productivity can enterprises be sustainable and profitable. A successful selection programme should focus on economically important traits identified to meet the goals of the enterprise. To do this, a sheep farmer or pastoralist should select and choose breeding stock based on performance records of traits that can be readily measured and accurately evaluated (Gipson *et al.*, 2007).

2.6.5 Breeding methods

Animal breeding is a branch of animal science that addresses the evaluation of the genetic value of domestic livestock. A breed is a group of domestic animals with homogeneous appearance, behaviour, and other characteristics that distinguish them from other animals (Schoenian, 2011). According to Dalton (2009), regarding livestock, there are different methods of breeding. Sheep normally attain full growth at the age of two years; however, this may vary from 18 months to three years with different breeds and localities. Ewes of age 18-24 months are generally used for mating. The rams are matured at one year of age but it is desirable to use rams for mating from age two and a half years to seven years of age (Khanvilkar *et al.*, 2009). In the Eastern Free State, some of the different breeding methods used are pedigree breeding, crossbreeding, interbreeding, inbreeding, and line breeding.

2.6.6 Reproduction and production

The productivity of smallholder farmers, especially in the livestock sector, is low and, as a result, studies have investigated the factors affecting farmers' inability to produce at full capacity. Certain factors have been identified to cause low productivity in this sector. This section will review some of the factors that affect the productivity of smallholder livestock farmers, with particular reference to smallholder sheep farmers in South Africa and Africa in

general. The factors can be sub-divided into production, inefficiency, and socio-economic factors (Nyam, 2017). Reproduction and production are interlinked; for effective reproduction, effective production is required. One must always strive for improvement; the offspring of the respective parents must always be better than the parents in terms of intended traits to be improved during reproduction. Production of high-quality and quantity stock should frequently be exploited. Increased efficiency is an important factor of productivity growth, especially when productive resources are scarce and smallholder farmers are living in extreme poverty. Maximising outputs while minimising the use of inputs is a technical problem faced in Africa, especially by smallholder farmers (Nyam, 2017).

Reproduction is the biological process by which new individual organisms – “offspring” – are produced from their “parents”. Reproduction is a fundamental feature of all known life; each individual organism exists as the result of reproduction (Johnson, 2007). Sheep production is the main core of the study; for efficient sheep production, farmers need to know the best practices of reproduction to gain maximum yield on production. In their natural state, sheep are seasonal breeders; offspring are born at the time most favourable for their survival. In some domestic sheep, the breeding season has been altered both naturally and through the use of hormones (Galal, 1983).

2.6.7 The impact of climate change on agricultural productivity

Climate change is one of the biggest challenges constraining smallholder agriculture in sub-Saharan Africa because of extreme weather conditions associated with climate variability. The region’s agricultural sector is highly sensitive to future climate shifts and increasing climate variability. Agriculture remains an important livelihood source for most rural sub-Saharan communities, providing employment for over 60% of its inhabitants and accounting for an estimated 30% of its GDP. The region experiences high temperatures and low (and highly variable) rainfall, the economies are critically dependent on agriculture, and adoption of modern technology is still low (Kruger & Shongwe, 2004).

Livestock production is also vulnerable to climate variability and change. According to Maponya and Mpandeli (2012), the impact of climate change in Africa is expected to exacerbate the vulnerability of livestock systems and reinforce the existing 34 factors that are simultaneously affecting livestock production systems, such as rapid population and economic growth, increased demand for food (including livestock) and products, and increased conflict over scarce resources (i.e. land tenure, water, and biofuels). This is supported by the fact that there is every reason to expect that African livestock will be sensitive to climate change (Intergovernmental Panel on Climate Change (IPCC), 2007). This also supports the view of

Delgado *et al.* (1999) that livestock systems in Africa are changing rapidly in response to a variety of drivers. Of the numerous factors that affect the productivity of livestock (sheep) farmers, climate change and location are significant. Livestock production contributes negatively to climate change, and climate change, in turn, also poses a serious threat to the ecosystem and global livestock production. More often, changes in climatic conditions, such as changes in temperature and rainfall, result in extreme natural occurrences, such as drought, floods, and windstorms, which are believed to affect the productivity and overall performance of livestock in terms of vulnerability to diseases, decreased birth rates, growth rates, and feed and water availability (Nyam, 2017).

2.6.8 Weaning

Some farmers have stated that they do not wish to keep lambs with ewes after 75 days because the ewe generally has little milk after this time. It is fair to say that at 75 days' lactation, the quantity of milk decreases but not that there is little or no milk after this time. In fact, lactation in the ewe can extend to 120 days (Schichowski, Moors & Gauly, 2008).

Keeping stress to a minimum at weaning time is important for the health and performance of ewes and lambs. Ewes should be dried up in their milk supply before being turned to pasture to prevent mastitis. Management practices and rations for the lambs should not be severely changed around weaning time. Lambs should be left in familiar surroundings during the weaning process. Ewes and lambs should be closely observed for health problems during weaning, and if problems arise, the farmers should act promptly with veterinary assistance (Neary, 1992).

Weaning is the time when lambs stop feeding on liquid milk or milk replacer. After weaning, lambs depend entirely on dry feed. This change has to be gradual to avoid losses due to faulty feeding management. Coccidiosis and pneumonia are the dominant diseases in this age group, particularly under conditions of confined housing. Decline of maternal antibodies and the stress of weaning appear to predispose lambs to respiratory infection (Yami & Merkel, 2011). Weaning lambs should not be done on impulse, but should be a well-planned activity. This is a critical period in the management of the flock and it should not be taken lightly (Ricketts, 1999).

2.6.9 Nutrition and management

According to Martin *et al.* (2004), some nutrition and management techniques can be used to improve the reproductive efficiency of sheep. Ewes can be flushed two to four weeks before

breeding. Flushing consists of increasing the quantity of energy, so that ewes gain weight. This will usually result in an increased lambing rate, a shorter breeding season, and a decreased number of open ewes (Martin *et al.*, 2004). Flushing seems to be more beneficial early in the breeding season with thin or moderately conditioned ewes, than later in the breeding season with fat ewes. Ewes should be kept off pastures containing high amounts of legumes (alfalfa, trefoil, clover) two to four weeks before breeding. The oestrogen content of these legumes can interfere with ewe reproduction (Neary, 1992).

Small stock production in South Africa is primarily dependent on natural vegetation as the nutrient source (Bezuidenhout, 1987). In an area with variable rainfall patterns and cold winters, fodder flow planning is possibly one of the biggest challenges in an animal enterprise. Increasing problems with predators, stock theft, and climate change (Kingwill, 2011), and the issue of rising production costs (Smith, 2004) are other challenges for the industry (Nel, Van Pletzen & Groenewald, 2010; Wessels, 2011), especially in the Southern Free State where pastures are only a side-line enterprise on a scale not always viable due to the rising costs of fuel, implements, and cultivation (Smith, 2004).

Freeman, Kaitibie, Moyo and Perry (2008) report that drought, widespread crop failure, animal diseases, and declining access to livestock services delivery increase vulnerability to food insecurity and affect all households in different ways. The ewe flock should have access to a free choice of salt and mineral mixture. The mineral mix should be designed for sheep to prevent potential copper toxicity problems (Mark & Root, 2006). Ewes that are healthy and fit during breeding are more likely to have multiple births and settle on the first service. Special attention should be given to feet, for foot rot or other problems. Rams and ewes should be dewormed prior to breeding so that flushing can have the maximum effect. According to Neary (2013), if there have been specific health problems, vaccinations can also be administered at this time.

Feed for the ewe flock represents the largest production cost in a sheep enterprise. This means that over nutrition and using costly feedstuffs and ingredients are expensive and undesirable. At the same time, under nutrition is also expensive due to lost productivity. Therefore, it is important to develop a nutritional management programme for the flock that optimises production while minimising feed costs (Johnson, 1997).

The nutrition and feed management of sheep must be monitored on a regular basis and feed resources must be well managed and readily available according to the animals' changing needs and environmental conditions. Sheep that are not fed adequately will lose body condition and will not perform to optimal capacity (Menke & Steingass, 1988).

Livestock rearing, mainly sheep and goats, is the mainstay of the land and most of the rural population depends on livestock and their by-products (Salem & Smith, 2008). Sheep output depends largely on feed intake by the animals – efficient feed use can increase the productivity of sheep production. During the survey, the participant farmers were asked about the type of feed they used for sheep production; for example, silage, fodder, mineral salt, and vitamins. The low use of feed could be due to financial constraints involved in either purchasing or producing feed, so most farmers allow their animals to graze on the field (Nyam, 2017).

2.6.10 Grazing management

Grazing management is an important tool in the efficient utilisation of the pasture resource. Appropriate choices of stocking or height of grazing and rotational or continuous stocking are critical to the success of a grazing system (Sollenberger, Vendramini & Newman, 2009).

Communal farming differs distinctly from commercial farming in terms of production systems, objectives, and property rights (Smet & Ward, 2006). The communal production systems are based on pastoralism and members of a community share the grazing areas. There are often unclear boundaries, with continuous grazing being practised. Rotational grazing as well as continuous grazing systems can co-exist, depending on the specific community's way of thinking at a particular time (Lohmann *et al.*, 2014). The outputs and objectives of livestock ownership are diverse, and include draught power, milk, meat, dung, cash income, and capital storage, as well as socio-cultural factors. Higher stocking rates in communal areas are common (FAO, 2005).

This communal system is under criticism in terms of exceeding the grazing capacity of the land and risking rangeland degradation (Palmer, Ainslie & Hoffman, 1999; McGranahan & Kirkman, 2013). Land degradation has been researched by various scientists in recent years, and can be defined as a decrease in either or both the biological productivity and usefulness of a particular area due to human interference (Levia, 1999). It is also described by Ayyad (2003) as the process by which habitat quality for a given species is diminished.

Overgrazing is considered as the most important cause of rangeland degradation in southern Africa (Van der Westhuizen, Snyman & Fouché, 2005). The effect of grazing management on the response of ecosystem structure and function are nevertheless inconstant, yet grazing intensity appears to be the most important driver of net primary productivity and composition, especially in semi-arid regions (Briske *et al.*, 2008). When the production potential of rangelands is over-estimated, the subsequent overgrazing will cause a decrease in palatable perennial plants in favour of less palatable and undesirable vegetation.

This situation leads to altered rangeland botanical composition, specifically a loss of vegetation covers in the grassland ecosystem (Han *et al.*, 2008; Ho & Azadi, 2010), and invasion of woody plants causing bush encroachment in the savannah ecosystem (Kraaij & Ward, 2006; Ward, Hoffman & Collocott, 2014). This severely threatens the economic viability of pastoralism in both ecosystems. The degree of these changes has largely been determined by management systems (Snyman, 1998; Tefera, Dlamini & Dlamini, 2010), which differ in land ownership (private or communal) and grazing intensity (rotational vs. continuous grazing). The further effect of animal trampling on soil chemical, physical, and microbiological properties, and the interaction between soil nutrients and vegetation are profound and needs to be understood (Tessema, De Boer, Baars & Prins, 2011). It is generally understood that veld management practices cause either the deterioration or improvement of the veld. Good veld management that provides for a growth season's rest every second or third year significantly improves both veld production and animal production. Various veld management systems are advocated and there certainly is no one ideal system that applies to all veld types. A practice that undoubtedly improves veld production, veld composition, and animal production is the implementation of a full rest in the growing season every second or third year. Seasonal rest not only allows plants to rest, but also to recover by building root reserves (Nel *et al.*, 2010). According to the Saskatchewan Ministry of Agriculture (2008), for long-term sustainability a grazing management plan must be designed with both plant growth and animal performance in mind, and there must be a balance between plant and animal requirements. Plant growth is maximised when they are "harvested" (or grazed) at maturity, but at that point the forage quality is low and animal performance may suffer because the nutritional needs of the animals are not met. Animal performance is maximised if the plant is grazed while it is actively growing (i.e. producing high-quality feed), but repeated, uncontrolled grazing will result in animals selectively consuming the highly nutritious and palatable plants while leaving the unpalatable ones. Over time, this will cause the disappearance of desirable plants (called decreasers) and the predominance of less desirable and undesirable ones (called increasers and invaders). Less time is spent grazing when forage is plentiful and of good quality, and more time is spent grazing when quantity or quality is limited. Herd animals tend to graze as a group when forage is plentiful and as individuals when forage is scarce; a well-established browse line indicates excessive grazing pressure (a browse line is a well-defined height to which browse, such as leaves, twigs, and woody growth, has been removed by animals), and midday grazing during hot weather indicates that forage is limited.

According to Munyai (2012), livestock systems are the largest land-use activity on earth. In developing countries, aside from the fact that livestock may be kept in the vicinity of the house or common land and fed with residue, there are also several other reasons why livestock is

kept. Sheep are more selective and tend to prefer grazing on forbs (broadleaf plants). Multi-species grazing can benefit the producer with better economic gains (different markets), predator protection, and improved range health (Campbell, 2003). Small ruminant production is the main source of income of farmers living in arid and semi-arid regions. Sheep and goats raised in these areas are generally confronted with severe nutritional deficits during periods of food scarcity, which exacerbates the occurrence of diseases and health problems and consequently leads to low productive and reproductive performance. These areas are characterised by rainfall seasonality and scarcity, which result in low fodder potential. Therefore, native rangelands are degrading due to overgrazing, high stocking rates, and mismanagement, which affect nutritional management to improve sheep performances in semi-arid regions (Salem, 2010).

2.6.11 Animal health

Livestock farming depends largely on the health of the livestock and, if more is spent on drugs for the livestock, productivity will be enhanced, since the healthier the livestock, the greater the output of the animal (Nyam, 2017). Disease and health problems of sheep are closely associated with management and nutrition. Medication cannot cure the results of poor management and poor nutrition. The first step in controlling a disease problem is to identify the disease. Producers should seek professional help from a qualified veterinarian. Autopsies and accurate health records can be helpful in improving the overall health programme. Any time drugs are administered to livestock, it is imperative that the drugs are used strictly as directed on the label, unless otherwise directed by a veterinarian (William, 2005).

Animal health is an important component in animal welfare. Animal health can be affected by many factors, including nutrition, ventilation, housing, and management practices. An animal's wellbeing is impacted by pain and discomfort. Health issues can cause pain and discomfort. Good animal welfare, therefore, requires good animal health (Nordquist *et al.*, 2013).

Maintaining healthy flocks and minimising diseases should be the goal of every sheep farmer; this goal can be accomplished by combining superior nutrition, timely management, and appropriate health practices (Ricketts, 1993).

2.6.12 Record keeping

The important role of keeping accurate records is to actually measure quantities. It is no use to, for example, guess the area of land or yields. Land should be measured using measuring instruments and yield of products should be weighed. The whole purpose of keeping records

and accounts is to make improvements. There is absolutely no value in spending time on records, calculations of profit, and production in individual enterprises if no use is made of them. All the results should be compared with some standards (Hemito, 2009).

The value and relevance of the different types of records will vary with differing sheep production systems. The following records should be kept:

- Health records: morbidity, mortality, signs and symptoms, diagnosis, treatments, vaccinations, etc.
- Feed consumption records: these are difficult to estimate on farms where animals graze, but for capital-intensive farm businesses, such as finishing or fattening operations, the amount of concentrate fed should be recorded to calculate profitability.
- Mating records: ram, ewe, and progeny identification are important in breeding, sales, and culling decisions.
- Lambing records: identity, ram identification birth weight, date of birth, type of birth, and sex.
- Milk production records: recording once weekly may suffice as this gives an indication of total milk production. Therefore, in dual-purpose sheep and goats, or even in meat types, a random sample of lactating females may be selected for recording their once-a-week milk production.
- Growth/weight records: kept periodically (possibly on a monthly basis) by recording the body weight of the animals.
- Inventory: inventory of available animals on the farm and other assets (Hemito, 2009).

Without records, it is impossible to address the production and management practices that affect overall productivity. With records, the tools for decision making are in place for problem solving, identifying management priorities, and setting production and marketing goals (Scott, 2011). There is no one sheep production system that will be profitable, competitive, and sustainable for everyone (Thomas, 2012).

2.6.13 Handling and transportation of animals

Handling refers to how agricultural animals are touched, moved, and interacted with during husbandry procedures. Performance standards during handling include careful, considerate, respectful, calm, humane interactions with animals in as positive a manner as possible. Animals handled in a respectful manner will be calmer and easier to handle than animals handled in a rough or disrespectful manner. Whenever possible, animals should be moved at

a normal walking speed, and acclimating the animals to handling and close contact with people will reduce stress (Boandl, 1989).

Socialisation of animals with humans should be done when feasible and when small numbers of animals are used for research. Socialisation and gentling can be carried out with relative ease by frequent exposure to kind, gentle care. Even brief periods of handling, beginning at the youngest possible age, confer advantages for ease of handling and increased feed efficiency, body weight, and antibody responses to red blood cell antigens (Gross & Siegel, 1982). According to Gross and Siegel (1982) and Jones and Hughes (1981), transportation performance standards include movement of animals with minimal risk of injury or death to the animal or handler. Making the transport experience more comfortable for each species should be a priority for animal handlers. Sheep and goats show strong flocking behaviour in pens as well as on pasture. Breed, stocking rate, topography, vegetation, shelter, and distance to water may influence flocking behaviours. Isolation of individual sheep usually causes signs of anxiety. Separation from the flock, herd, or social companions is an important factor that causes sheep and goats to try to escape. Sheep and goats tend to follow one another, even in activities such as grazing, bedding down, reacting to obstacles, and feeding (Hutson, 2007).

When handling sheep, these characteristic behaviours should be considered and used advantageously and, more importantly, for the best interest of the animal's health and welfare. When transporting sheep, one should take into consideration the climatic conditions, and productive, well-designed restrainers should support the animal's body and should not have sharp pressure points; sheep can easily be trained to enter head stanchions (Barber & Freeman, 2007).

All people involved in planning a journey and mustering, assembling, handling, selecting, loading, and transporting sheep are responsible for their welfare. They should communicate effectively to support those with key responsibilities, and should ensure that management systems are in place to minimise risks to sheep welfare (Land Transport of Sheep Standards and Guidelines (LTSSG), 2011).

2.6.14 Meat production

Meat consumption in South Africa has expanded rapidly over the past decade and while continued growth in meat consumption is projected in the coming decade, slower economic growth will result in slower consumption growth relative to the past. South Africa's economy is expected to grow by less than two percent in the next three years, as lower commodity prices, labor unrest, a weak exchange rate and prospects of a weaker global economy will impact

negatively on economic growth. Economic growth is the main overall driver for the increased demand in meat (DAFF, 2014).

Maree and Casey (1993) regard sheep meat as a valued food item in Africa, with the average price per kilogram being up to 25% more than for beef. More than 70% of sheep are marketed as lambs. Consumer preferences for lean carcasses favour the later maturing breeds like the SA Mutton Merino and the Ile de France. In South Africa sheep are slaughtered and meat is mostly used in traditional ceremonies and even for lobola and in suitable localities sheep offers income from wool, mutton and lamb. Almost every part of the sheep is useful for household consumption, beside meat production milk, wool and skin can be sold for income. Farmers in the Thabo Mofutsanyana district have option of making income through sheep production as a source of meat production and other secondary sources like wool and skin.

2.6.15 Marketing

As per the FAO (2004), the total global annual meat production is from cattle (63%), sheep (25%), and goats (12%). At the national level, sheep and goats account for about 90% of live animals / meat and 92% of skins and hides (FAO, 2004). Most farmers interviewed in this study sold their wool via agents, by which the wool is classed by weight, grade, and age and submitted to the agent to market the wool on behalf of the farmers. Small-scale operators and part-time producers, in particular, have the opportunity to market additional services or special aspects of their product and realise significant price premiums.

According to Penn State College of Agricultural Sciences (2017), four types of activities are generally considered as direct marketing of livestock:

- i. Selling directly to a packer/buyer on a live or grade and yield basis. This is the textbook type of marketing referred to as direct marketing in many market summaries and reports.
- ii. Setting up a slaughter facility and merchandising carcasses or retail cuts directly to the consumer.
- iii. Selling the live animal to the consumer, who has the responsibility of making slaughter arrangements either by actions or direct sales to feedlots.
- iv. Selling all or parts of the carcass to the consumer after slaughter by an established butcher shop.

Farmers in the Thabo Mofutsanyana district have few options in terms of marketing and making sales to their clients; they mostly sell stock during holidays and private sales to private

buyers. However, the backbone of any business is the effectiveness of its marketing campaign. Without implementing successful marketing techniques, companies will not sell products and businesses will not thrive. There are many different types of marketing methods useful for showcasing products to consumers. One common type of marketing method is direct marketing. The following are some advantages of direct marketing in relation to other selling methods (Gordon, McDermott, Stead & Angus, 2006):

- **Higher prices for small groups:** By selling directly to the consumer, the producer sets the price and does not experience the price discrimination generally encountered when selling small groups of animals.
- **Higher prices for leaner and lighter-weight animals:** Small-scale producers can market animals to their own specifications without the large discounts experienced in markets involving packers/buyers.
- **More net profit:** A combination of higher selling prices, no sales company or buyer commissions, and lower purchase prices can help improve profitability.
- **Better cash flow:** By setting their own price and standards for the number fed and sold, market weight, and amount of finish, producers may know the market price prior to selling and perhaps even prior to purchasing or producing the feeder animals.

Improving the marketing success of livestock producers provides incentives to adopt technological interventions that improve livestock productivity, which in turn improves marketing success. Access to the local market is the most important economic determinant in adopting technologies (Zelalem, 2007) and choosing production enterprises.

Market locations in primary and secondary markets are usually not fenced; there are no permanent animal routes and no feeding and watering infrastructures. Yet buyers and sellers are subjected to various service charges by the local authorities as well as other bodies. The more mobile trader is better informed on market prices which, combined with excess supply, places the trader in a better position during price negotiation (Tesfaye, 2009).

Traders and exporters are also faced with marketing problems. A survey in Ethiopia on Improving Productivity and Market Success (IPMS) (Gebremedhin *et al.*, 2007) identified a lack of adequate supply of good-condition animals, inadequate marketplaces, lack of holding (concentration) places, lack of feed supply, lack of market information, multiple taxation at checkpoints (especially when animals are trekked or trucked through towns), and lack of efficient vaccination services for export animals as the major problems. The problems experienced by exporters include lack of adequate supply of appropriate and good-quality animals, poor marketing infrastructure, livestock diseases, lack of adequate sanitary and

phytosanitary services to support exports, long market channels (usually three to five stages between producer and the abattoirs), and problems with airfreight transport services. These producers can sell sheep to either feedlots or to abattoirs. The feedlots provide sheep for slaughter to abattoirs. Abattoirs deliver meat, hides, and skins. Meat is the primary product that abattoirs deliver to either exporters for foreign markets, while wholesalers provide to various retailers or processors (DAFF, 2014).

2.6.16 Sheep production systems

Systems for sheep production vary from extensive free-ranging to controlled grazing or zero-grazing feedlots. The type of system depends on the environment, the product, the degree of control required and the preferred management programme. Extensive grazing systems are well suited for wool production with Merino sheep, and meat production with Merino types and Dorper sheep (Maree & Casey, 1993). Spedding (1988) argues that the ultimate goal of agricultural research should be to improve the whole farming system, not just a component of it. There are four different sheep production systems, namely extensive sheep production: rangeland only, semi-extensive sheep production: rangeland supported by irrigated pastures and two intensive sheep production system using irrigated pastures and silage respectively for production.

All four sheep production systems can be profitable over the long term with a positive profit margin. The cheapest pasture and method of utilisation is direct grazing on natural veld (Louw, 2012). Landmand (2013) indicated that Maluti a Phofung grassland portion of the natural veld is larger in this system with a complete extensive natural grazing enterprise with irrigated pastures as supplementary feed to utilise during winter and lambing season, the main source of feed for the sheep was the natural vegetation, consisting mainly of grassland and a few Karoo bushes. Maree and Casey (1993) also agreed that extensive natural grazing enterprise with irrigated pastures are used as supplementary feed to utilise during winter and lambing season, if the main source of natural vegetation feed for the sheep is inadequate.

The grassland portion of the natural veld is a dominant system in an extensive natural grazing enterprise in comparison to the other irrigated systems, and mostly the only source of feed utilised by the sheep is natural vegetation (Landmand, 2013). According to Nthakheni (2006), in extensive natural grazing areas including Maluti a Phofung, sheep are exposed to effects such as predators, theft and extreme weather conditions, and rock salt is often the only supplementary feed given to sheep. In this extensive natural grazing

system sheep have the capacity to express the full range of their natural behaviours, although some aspects of their normal social organisation are disrupted, these disruptions include weaning earlier than would occur naturally, segregation of sheep on the basis of age and sex and various husbandry operations, which can cause pain or stress (Nthakheni, 2006).

The main potential source of welfare problems for sheep under these systems arise from their interactions with humans, which are usually stressful and aversive. Welfare challenges also arise in these systems due to the early weaning of lambs and handler interaction, which can be a source of stress (Nthakheni, 2006). A diverse range of sheep breeds are managed in different systems. The systems generally have the capacity to provide good welfare for the animals kept within them, provided that adequate resources (e.g. supplementary feed, labour) can be provided when required. Under extensive conditions, small size is a desirable adaptive attribute, generally associated with early and regular production attributed to the inherent fertility of the tropically adapted animals. Maree and Casey (1993) also indicated that under extensive grazing systems it is economically important to reduce costs related to handling facilities, drugs, and labour.

A challenge for pastoral farming, considering biological, physical, and economic factors, is to be profitable and sustainable. Small-scale farmers in the study area mostly practise extensive sheep production, and rangeland and semi-extensive sheep production, in rangeland supported by irrigated pastures. Wool prices and reasonable meat prices encourage sheep production, especially wool sheep farming. It is important not to change to sheep production systems using irrigated pasture or some other form of intensive sheep enterprise without careful planning and consideration. Some production systems are dependent on irrigated pastures for the whole year, such as grass and clover mixtures. Changing enterprises without careful planning is not always a good idea, because costs and risks are involved (Warn *et al.*, 2006). Planning is important as it will further enhance the understanding of production systems and their drivers, both nationally and globally (Deblitz & Zimmer, 2007).

Livestock production systems and the constraints that go along with how the smallholder livestock owners survive are highly importance. Agricultural farming systems are considered an appropriate vehicle for better understanding livestock production systems. Nthakheni (2006) argues that farmers' local knowledge base, combined with the synthesis of scientific knowledge and new techniques, is essential as this knowledge base helps in understanding

these complex systems in order to develop intervention strategies and practices that may stabilise and sustain livestock production in these areas. It is important to consider livestock production systems in resource-poor areas with particular reference to other world experiences, starting with inquiry methods suitable or relevant to such situations. The environmental consequences of livestock production vary widely, depending on the opportunities and constraints afforded by different production systems (Nthakheni, 2006).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this project was to evaluate small-scale farmers' management of sheep production systems a selective area of the Eastern Free State. This chapter will also discuss the research instrument, research design, study area, data collection procedure, data analysis, technology transfer/ application of results, industrial/community relevance and ethical consideration.

3.2 Study area

The Thabo Mofutsanyana District Municipality in the Eastern Free State comprises of seven local municipalities namely Maluti-a-Phofung, Dihlabeng, Setsoto, Nketoana, Mantsopa, Phumelela and the Golden Gate Highlands National Park. The research was conducted in the Maluti-a-Phofung Local Municipality and is portrayed in Figure 2.

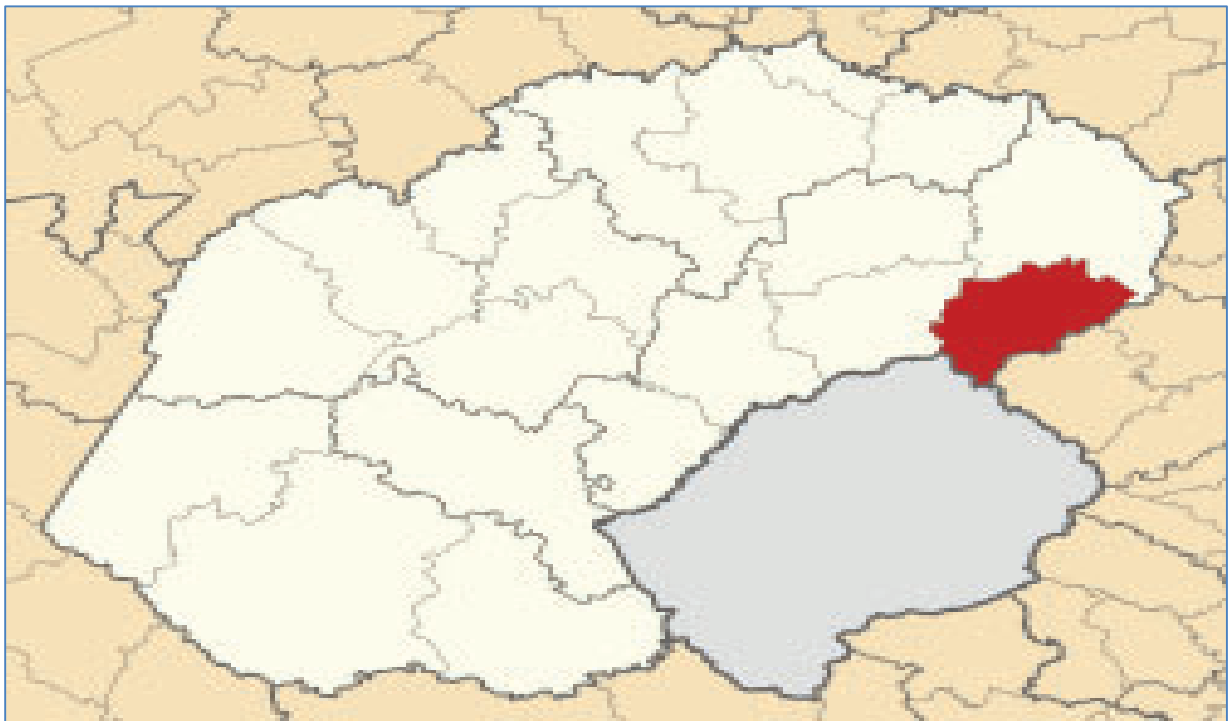


Figure 2: The area of study in the Eastern Free State (Maluti-a-Phofung Local Municipality)

The Free State lies in the heart of South Africa, with the Kingdom of Lesotho nestling in the hollow of its bean-like shape. Lying between the Vaal River in the north and the Orange River in the south, the region is one of flat, rolling grasslands and crop fields, rising to lovely sandstone mountains in the northeast. The Maluti-a-Phofung Local Municipality is situated in the Eastern Free State. Maluti-a-Phofung is a local municipality that was established on 5 December 2001, and comprises four former local authorities, which are QwaQwa Rural, Phuthaditjhaba, Harrismith, and Kestell. The municipality is comprised of 35 wards and covers approximately 4 421 km in extent. Phuthaditjhaba is the urban centre of QwaQwa and serves as the administrative head office of the Maluti-a-Phofung Local Municipality. Surrounding Phuthaditjhaba are the rural villages of QwaQwa, established on tribal land administered by the Department of Land Affairs. Harrismith is a service centre for the surrounding rural areas and a trading belt serving the national road, N3, which links the Gauteng and KwaZulu-Natal provinces. Harrismith is surrounded by Tshiamo, located 12 km to the west, and Intabazwe, which is located 1.5 km to the north. The town is an economic hub for people living in Tshiamo, Intabazwe, and QwaQwa. Kestell is a service centre for the surrounding agriculture-oriented rural area, with Tlholong as the township. Kestell is situated along the N5 road that links Harrismith with Bethlehem. The rural areas of Maluti-a-Phofung comprise commercial farms and major nature conservation centres such as QwaQwa National Park, Platberg, Sterkfontein Dam, and the Maluti mountain range. The area is not only a tourist destination, but also makes a big contribution in generating gross agricultural income for the whole province and is also highly regarded for its beef production. The vegetation of the eastern Free State comprises a mosaic of woody and grass-dominated vegetation units with short to tall sour grasses constituting the majority of the species' composition (Brand *et al.*, 2006).

Table 1 shows that the Thabo Mofutsanyana District Municipality had an overall population of 736 238 (according to the 2011 census) and a possible growth per annum of -0.61%, with an unemployment rate of 35.10% and, alarmingly, a youth unemployment rate of 45.8% (Stats SA, 2011).

Table 1: Agricultural household farming statistics for the Thabo Mofutsanyana District Municipality

Population overall	736 238
Population under 15 years	31.90%
Population under 15 years to 65 years	62.60%
Population over 65 years	5.50%
Population growth per annum	-0.61%
Labour market	0.12 %

Unemployment rate	35.10%	
Youth unemployment rate	45.8%	
Household livestock farming	Free State	South Africa
Cattle only	18.9%	8.7%
Sheep only	1.8%	1.3%
Goats only	0.8%	5.8%
Pigs only	3.8%	2.2%
Poultry only	36.8%	30.8%
Combination of animals	38.0%	51.3%

Source: Stats SA (2011) and Stats SA (2016)

Agriculture plays a significant role in the economy of South Africa. Table 1 indicates the population distribution within Thabo Mofutsanyana district and household farming with specific livestock in the Free State and South Africa. In 2012, agriculture contributed around 2% of the GDP (Stats SA, 2013).

The site was selected based on recent statistics by Stats SA (2011) on the number of households engaged in agricultural activities in the area. Noticeably, the Western Cape, Eastern Cape, and Northern Cape provinces are considered the highest wool producers in South Africa, and the Free State is considered one of the lowest producers, despite the many wool farmers in the region.

3.3 Data collection

A questionnaire was used to collect data (primary data). According to Van Niekerk and Truckman (2002), questionnaire survey methods make it possible to measure what a person knows and the type of information he/she possesses, the values and beliefs of the person, and the attitudes towards the questionnaire's topic.

When conducting a questionnaire survey, administered questionnaires deliver better results (Van Niekerk & Truckman, 2002). The questionnaire survey can be used in three different ways; namely personal interviews, telephonic interviews, and mail interviews (Randela, 2005).

The study made use of personal interviews because it enabled the interviewer to observe behaviour that the questionnaire was not designed to detect. The questionnaire was relevant to the objectives of the study and the respondents involved in the study. Forty small-scale farmers randomly participated and were interviewed.

The information used in this study was collected by means of primary data. Structured questionnaires were used to gather the required data. The structured questionnaires were designed to address the objectives of this study. The questionnaires were structured with open- and closed-ended questions, and the information was gathered through personal interviews.

The reason for using personal interviews was to obtain as much detailed information as possible. The random sampling method was used so that every small-scale farmer in the Maluti-a-Phofung Local Municipality had an equal opportunity of being selected. The expected number of respondents to be interviewed was 40, out of a total of approximately 70 farmers in the area. There is no prior information on the subject matter in the study area. The farmers, who were willing to participate, eventually informed the total number of farmers interviewed. The PivotTable method was used in Microsoft Excel (2007) to obtain and analyse the data.

3.4 Data analysis

The Statistical Package of the SAS Institute Inc. (1999) was used to capture the coded data. This made it easier for the researcher to identify mistakes before analysing the data in SAS and Statistical. The Institute for Statistical Consultation at the Agricultural Research Council conducted the processing of the data, using SAS and Statistical, which are software used for statistical analyses. The percentages calculated were based on the total number of farmers who responded to a particular question. The farmers who did not respond to a particular question were excluded from the calculation of percentage values for that question. When a farmer selected more than one answer or gave more than one method to a question, percentages were calculated for each group of similar answers.

3.5 Technology transfer / application of results

The research targeted small-scale farmers who specialise in sheep production in the Maluti-a-Phofung Local Municipality. The results (recommendations) could be implemented through the agricultural extension officers. These results will also be forwarded to interested parties such as agricultural institutions (private and public). This study will recommend better sheep management and husbandry practices as recommendations will be provided to targeted farmers to implement the recommendations.

3.6 Industrial/community relevance

The Eastern Free State, in the Maluti-a-Phofung Local Municipality under the Thabo Mofutsanyana District Municipality, consists of rural areas that are a host/farming area for other small-scale farmers in this study who were previously deprived of socio-economic benefits, including access to education, and relevant agricultural innovations, which would assist in their management of sheep farming. The largest percentage of the clip is sold through the auction system. Auctions have been centralised in Port Elizabeth and take place once a week during the season (August to June). Even though centrally auctioned (i.e. sale by separation), wools are warehoused in three of the four ports, namely Port Elizabeth, Cape Town, and Durban.

Prices paid for Cape wools are determined by free market supply and demand forces and are closely linked to the international price for apparel wool, which is determined by the Australian market. Most of the clip is marketed overseas through members of the South African Wool and Mohair Buyers Association (SAWAMBA). Only registered members of SAWAMBA are allowed to bid at auctions held under the auspices of the South African Wool Exchange. This research will help to educate small-scale farmers and assist them regarding entry into the sheep industry and knowledge of the market.

3.7 Ethical considerations

Ethical considerations for the current study to improve and maintain good and healthy relations with the study group, government departments, and individuals from whom support and cooperation were required included the following: 1) application of the principles of fairness and justice, 2) application of the principle of autonomous subjects, 3) application of the principle of doing good, and 4) application of the principle of avoiding doing harm. To make sure that all four ethical principles were applied in the study, farmers were made aware at least five days before the visit and informed about the purpose of the visit. The questionnaires were anonymous, which ensured confidentiality, which aims to protect the confidential information of the participants of the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The information that follows resulted from a descriptive analysis of the data collected. The results are presented using descriptive statistics frequencies, counts, charts, percentages, and standard deviations. All respondents were interviewed on their farming area by appointment. Interviewing the respondents on their farming area permitted the researcher to observe their farming areas. The respondents were asked to motivate their answers to verify whether they understood what they were being asked. In this regard, all the results in the present study are assumed to be correct and valid.

The study used data collected from a sample of 40 emerging farmers using a questionnaire survey. All 40 farmers were engaged in livestock rearing; about 10 of whom were also engaged in crop production.

4.2 Demographics

Van Schalkwyk, *et al.* (2012) identified variables such as location, age, education, access to credit, membership of farmers' union, market distance, and land size in their various studies on the challenges affecting smallholders in the country. In constructing a descriptive profile of smallholder farmers, some of the variables identified by Van Schalkwyk *et al.* (2012) were used in order to create a structured and comprehensive profile of the small-scale famers in the survey.

Similarly, Salami, Kamara and Brixiova (2010) identified variables such as land tenure and farm management, access to input and output markets, infrastructure, and institutional matters as key to small-scale famers' development, which were also considered in this research to build a profile of small-scale famers in the study area.

Figure 3 provides an indication of the ages of the respondents grouped into three categories namely 1) 15-34 years, 2) 35-64 years and 3) 65 years and older.

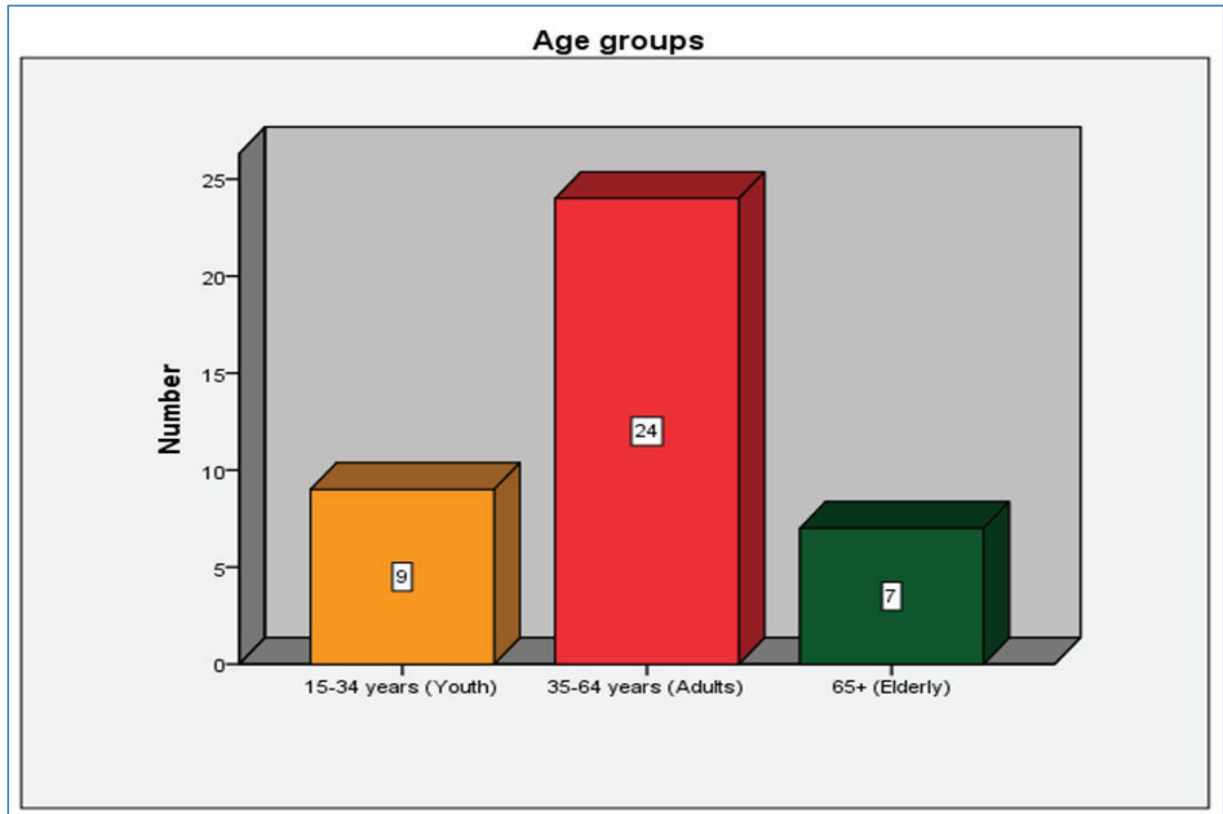


Figure 3: Age of the respondents

From Figure 3 it is evident that most of the farmers in this study were adults (24, or 60%, were aged 35-64 years), followed by nine youth (aged 15-34 years) farmers (22.5%). The figure also shows that only seven (17.5%) of the farmers were elderly people aged 65 years and older. The majority of the farmers were older than 40 years of age, which may be an indication that the younger generation prefers not to get involved in agricultural activities, particularly farming, but would rather migrate to urban areas in search of better salaries and jobs. According to Gombe *et al.* (2016), agricultural extension can play a role in educating the community regarding the benefits of agriculture and emphasises the possible role agricultural extension can play in the improvement of management practices. The aged participants also displayed the knowledge gained through the years by how they articulated their responses.

Of the 40 farmers who participated in the study, 35 (87.5%) were male and five (12.5%) were female. This indicates the general farming demographic of the region; Agricultural extension can play a role in educating more females about the benefits of agriculture.

According to Stats SA (2011), less than a quarter of South African households (22%) are involved in agricultural production, with those involved in agriculture engaged mostly in the production of food and grains (43.4%), fruit and vegetables (30.1%), poultry (43.9%), and livestock (49.4%). Most crop production takes place in backyard gardens (87.6%) According

to Smet and Ward (2006), commercial livestock and game farming are managed by persons with secondary education and others with tertiary education, while both these management systems also enjoy the support of South African agricultural research institutes.

Smet and Ward (2006) further indicate that communal livestock farming has been based mainly on traditional management systems, which are managed by individuals without any formal training in either animal husbandry or veld management. This situation is further complicated by no one person actually being in charge. Comparative findings relating to commercial ranching, communal livestock ranching, and game ranching management systems indicated that communal livestock ranches are expected to have a more detrimental effect on rangeland conditions than the other management systems because the stocking densities and, consequently, herbivore impacts, are usually far higher than under the other two management systems (Kreuter & Workman, 1997).

Figure 4 provides an overview of the educational status of the respondents.

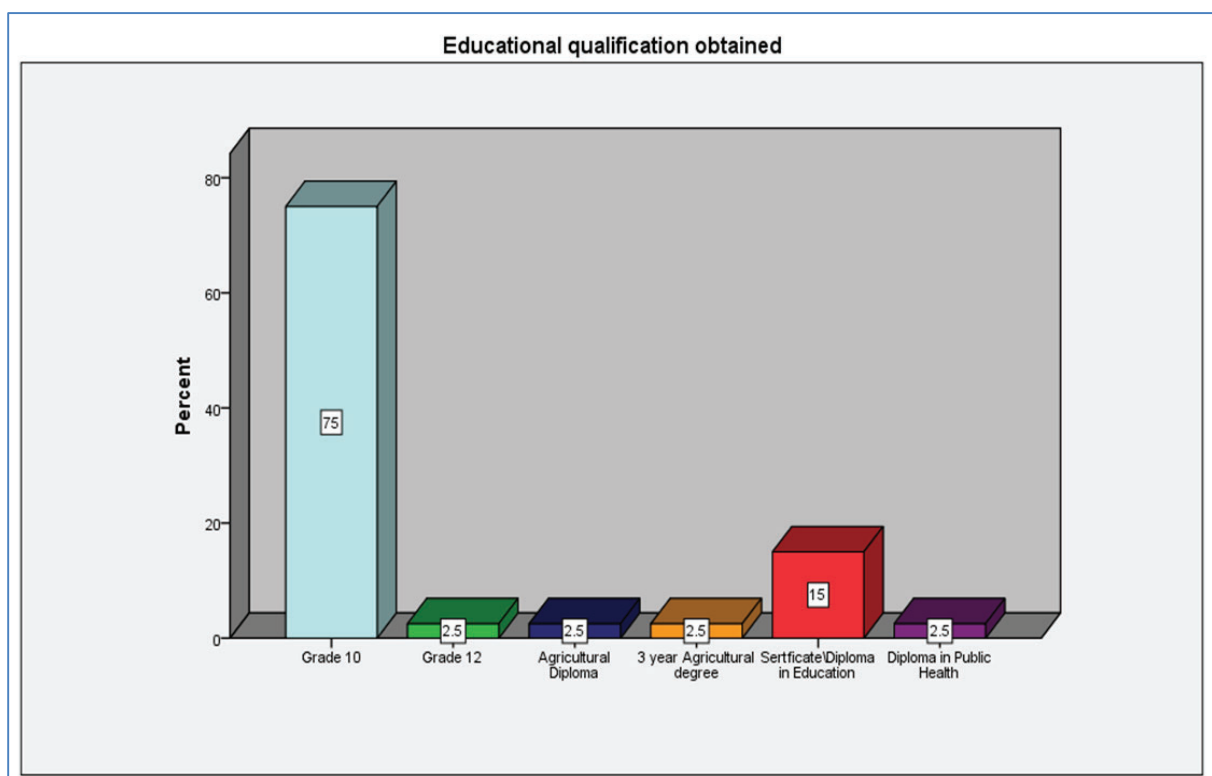


Figure 4: Educational status of the respondents

Figure 4 depicts that 75% of the farmers had completed Grade 10, 2.5% had completed Grade 12, 15% had a diploma or a three-year degree in Agriculture, 15% had a certificate/diploma in Education, and 2.5% had a diploma in Public Health. The majority of the farmers were therefore educated up to the end of high school. A business in general requires someone who

is open-minded and who has the ability to quickly grasp concepts; a low level of agricultural education is one of main management challenges small-scale sheep production farmers encounter in the Eastern Free State. Agricultural education assists with skills such as record keeping and banking skills, labour management, and the ability to choose a profitable enterprise and suitable production method(s) for that enterprise (Khapayi & Celliers, 2016). Agricultural production methods in particular are dynamic and require that farmers are knowledgeable and up to date with the latest developments and changes. Agricultural extension can play a role in increasing methods to access of information for support services.

4.3 The management challenges encountered by small-scale sheep production farmers in the study area

4.3.1 Farming experience

According to Joubert (2013), the Agricultural Sector Education and Training Authority (Agri-SETA) in 2010 identified a range of scarce skills in agriculture. At small-scale level, it was found that farmers lacked skills in a host of areas, namely farm management and entrepreneurship, resource management and record keeping, financial planning and management, marketing, processing and packaging, transport, natural resources management, and mechanical and electrical knowledge.

In the commercial sector, the critical constraint identified was the poor educational levels of a large proportion of the labour force, which demanded considerable investment in adult basic education and training and other life-skills programmes. Agri-SETA also found that commercial farmers needed to improve their management, business, and marketing skills; develop more environmentally responsible production and processing systems; raise environmental, health, and safety compliance; and make more progress towards meeting international trade standards (Joubert, 2013). Farming skills required to be improved frequently by attending relevant available trainings offered by different institutions.

Figure 5 illustrates the farming experience of the respondents over years. It is assumed that if a farmer has knowledge of a certain aspect, it will be easier to gain experience along the way (Khapayi & Celliers, 2016). Similarly, if a farmer has experience in certain aspects, then the farmer will gain knowledge from that experience. The experience can be equated to knowledge to differentiate between what is wrong and what is right.

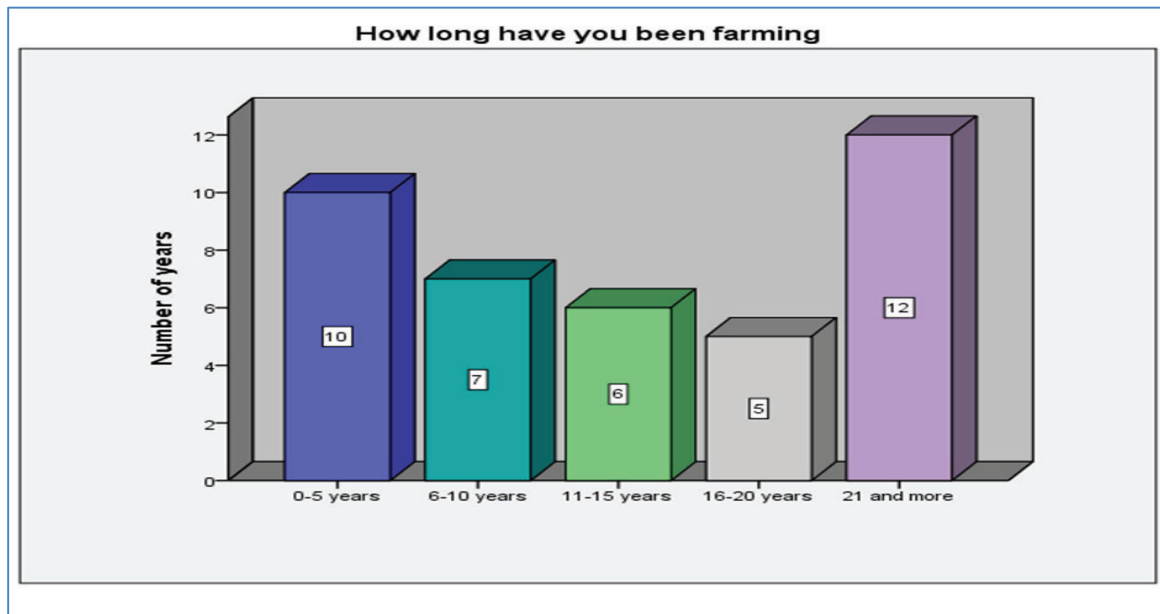


Figure 5: Farming experience of the study group

The results indicate that the farmers surveyed in the study were reasonably experienced in farming; with 17 farmers (42.5%) having 16 years and more years of farming experience and 17 (42.5%) having 10 years or less of farming experience. Six farmers (15%) had between 11 and 15 years of experience. The relationship between the respondent's experiences and their management practices will be discussed later in this chapter.

4.3.2 Health management

In animals, health may be defined as the absence of disease or the normal functioning of an organism and normal behaviour based on the observation of a certain number of individuals that determine the standard and thus health (Baker & Greer, 1980). In production sectors, health may also be defined as the state allowing the highest productivity. However, this narrow definition often is enriched by the concept of a balance between the animal and its environment, and of the animal's physical welfare. This broader definition undoubtedly is linked to changes observed in the field of veterinary medicine, which is focusing increasingly on prevention rather than cure, and which takes the animal's environment into fuller account (Gunnarson, 2004) Animal diseases may be organised schematically into three categories. Multifactorial diseases are provoked by a set of risk factors linked in particular to livestock management, with at times the participation of pathogens widespread in livestock. Known as "production diseases", multifactorial diseases are present on a large majority of livestock farms with highly variable frequencies.

The major epidemic diseases are highly contagious and impact livestock heavily (for example, foot-and-mouth disease, swine fever, highly pathogenic avian influenza); the challenge is to eradicate such diseases from a territory when possible, and their appearance in a totally susceptible population can have extensive health and economic consequences. (Ducrot *et al.*, 2011) Animal welfare issues are related closely to changes of regulations in this domain. Diseases induce suffering and pain, the absence of which is one of the criteria chosen for recently proposed animal welfare evaluation tools (Botreau *et al.*, 2007). Livestock and agro-food sectors play a central role in industrialised countries, reaching 53% of the GDP (Thornton, 2010).

Food security and safety, extensive economic activities linked to supplying the livestock sector which include the pharmaceutical industry, and the valorisation and trade of agricultural products and food that often are very technologically advanced), as in developing countries (subsistence agriculture, food security, intake of quality protein). In a report on the state of food and agriculture in the world focusing on livestock, the FAO (2011) summarised these different issues at stake as follows:

“Animal diseases, and a lack of adequate food hygiene resulting in foodborne illnesses, are a problem for everyone because they can threaten human health, disrupt markets and trade, reduce productivity and deepen poverty. Improving the management of livestock with a view to preventing and controlling disease can provide significant economic, social, and human health benefits for the poor and for society at large.”

Among the report's four key messages, it is noted that, "Livestock diseases pose systemic risks that must be addressed." The results showed that the most prevalent diseases affecting the farmers in the study area were pulpy kidney, Rift Valley fever (RVF), sheep scab, and blue udder. Fifty-two percent (52%) of the farmers vaccinated against pulpy kidney, RVF, blue tongue, and sheep scab, while 58% vaccinated against pulpy kidney, RVF, blue tongue, and blue udder, depending on the availability of funds in that period. It is evident that farmers cannot always afford vaccines, which results in lamb deaths and this indicates that government support in terms of funding to assist in buying medication is a challenge experienced by small-scale farmers.

4.3.3 Marketing skills and challenges

Table 2 illustrate that 66% of the farmers surveyed in the study in the Maluti-a-Phofung Local Municipality made sales in non-formal markets where customers came to choose from different farmers' stock in different kraals what they would like to buy, based on their affordability and preference at that time. Forty-four percent (44%) of farmers have formal markets, such as

selling to abattoirs. These results indicate that access to information about marketing is one of the main management challenges that small-scale sheep production farmers encounter in the Eastern Free State.

Montshwe (2006) argued that the difficulties smallholder farmers face in accessing information about the market exposes them to serious marketing disadvantages. Due to weak public information systems, according to Mangisoni (2006), smallholders normally accept low prices for their produce when the broker informs them that their produce is of poor quality. They accept these unacceptably low prices because of poor bargaining skills and an inability to negotiate from a well-informed position. The various challenges facing smallholder farmers in accessing both local and international markets can be summarised as follows based on a survey of literature and international experience. One of the many challenges farmers face is high transport cost as it plays a vital role in marketing the farmers' livestock, because transport links the farmers to the markets or customers.

Table 2 indicates that 66% of the respondents surveyed marketed their sheep privately and 44% sold sheep to abattoirs. Twenty-eight farmers surveyed indicated that they are members of the Qwaqwa Wool Grower Association that shear the sheep once a year and class wool according to categories. The wool is then sold to BKB under producer number 611030A6. The other 12 respondents sell their wool privately to private buyers. The results illustrate that marketing may be a management challenge these farmers encounter as the majority of the farmers did not market through formal marketing mechanisms. Agricultural extension can play a role in educating farmers about the benefits of being a member of the Wool Grower Association.

Table 2: Preferred type of marketing

Preferred marketing	Percentage of respondents
Marketed their sheep privately	66%
Sold sheep to abattoirs	44%
Total	100%
Wool buyers	Number of respondents
Private buyers/ middle man	12
BKB	28
Total	40

Transport availability is crucial in the management of production systems as unreliable transport can lead to the late delivery of products (Khapayi & Celliers, 2016). Table 3 illustrates that 52% of the farmers used own transport to transport animals to the market, while 28% hired

transport and 20% relied on the buyers' transport. The results illustrate that transportation to the market may be an expensive cost component small-scale sheep farmers encounter in the Eastern Free State.

Table 3: Preferred transportation to the market

Preferred transportation to market	Percentage of respondents
Own transport	52.0%
Hired transport	28.0%
Buyer's transport	20.0%
Total	100%

4.3.4 Farming equipment owned by farmers

Equipment used in agriculture is particularly significant for improving agricultural productivity since it facilitates soil cultivation, crop planting, weeding, fertilising, irrigation, and harvesting. In addition to the benefits offered by more advanced equipment, other changes in tools and work methods significantly reduce human burden and fatigue and improve farm productivity (Kumar, 2011). Education and frequent visits of extension agents to train farmers on how to use machines, and making it possible for smallholders to access and afford machines and other agricultural equipment, are important for increasing small-scale agricultural production (Owombo, *et al.*, 2012).

Equally, farming equipment is essential for a sheep farmer as it is required for activities like dosing, dipping, castration, vaccination, and the treatment of sick animals, which should be carried out timeously by the farmer. Table 4 provides an indication of the availability of different types of farming equipment to the respondents.

Table 4: Essential farming equipment

Essential farming equipment	Number of respondents
Dosing gun and syringe	7 respondents (17.5%)
Dosing gun, syringe, castration equipment, and hoof shears	5 respondents (12.5%)
Dosing gun/syringe and hoof shears	3 respondents (7.5%)
Respondents that own less than two set of essential equipment (Dosing gun, syringe, castration equipment, and hoof shears)	25 respondents (62.5%)

Table 4 illustrates that only seven farmers (17.5%) had a dosing gun, hoof shear and burdisso; five (12.5%) had a dosing gun/syringe, castration equipment, and hoof shears; and three (7.5%) had a dosing gun/syringe, Aussie tag applicator and hoof shears. The remaining 25 farmers (62.5%) that own less than two set of essential equipment (Dosing gun, syringe, castration equipment, and hoof shears) that assisted them, but they usually improvised or borrowed from other farmers. The results thus indicate that a lack of farming equipment is one of the challenges experienced by these small scale farmers.

4.4 Constraints experienced in sheep production systems by small-scale farmers

4.4.1 Reproduction and production management

The results (Table 5) indicate that mean lambing percentage for all three districts (Maluti a Phofung, Setsoto and Dihlabeng) is 91%. The Dihlabeng district had the highest lambing percentage at 104% as compared to the other two districts (Maluti a Phofung and Setsoto) with lambing percentages of 87% and 85% respectively. The results indicate that there may be possible constraints experienced in sheep production systems by small-scale farmers in some districts that result in less than 100% lambing percentage.

Table 5: Lambing percentage per location

Location	Lambing percent
All area	91%
Dihlabeng	104%
Maluti	87%
Setsoto	85%

Table 6: Fertility tests versus number of lambs born alive in the previous lambing season

Fertility tests	<50% lambs born alive
Clinical tests	50%
No action taken	40%
No fertility problem	71%

Table 6 indicates that 71% of the farmers who did not experience fertility problems previously had less than 50 lambs born alive. Approximately 40% of all farmers who took no action during the previous mating season had less than 50 lambs born alive, which is higher than the percentage of the farmers (50%) who conducted clinical tests (which included self-examination and reproductive organs examination). It can, therefore, be concluded that the use of only clinical examinations, does not guarantee higher lambing rates. The results also indicate that reproduction and production management are some of constraints experienced in sheep production systems by small-scale farmers.

Furthermore, the farmers who performed self-examinations and clinical tests all indicated that they also identified multiple lambs with ewes that were mated, compared to less than 50% of farmers who did not take action. The results indicate that testing rams for fertility may influence the number of lambs born. Agricultural extension can play an important role in educating farmers that testing rams for fertility may influence the number of lambs born. Figure 6 illustrates the response to the questionnaire question: “at what age are ewes mated?”

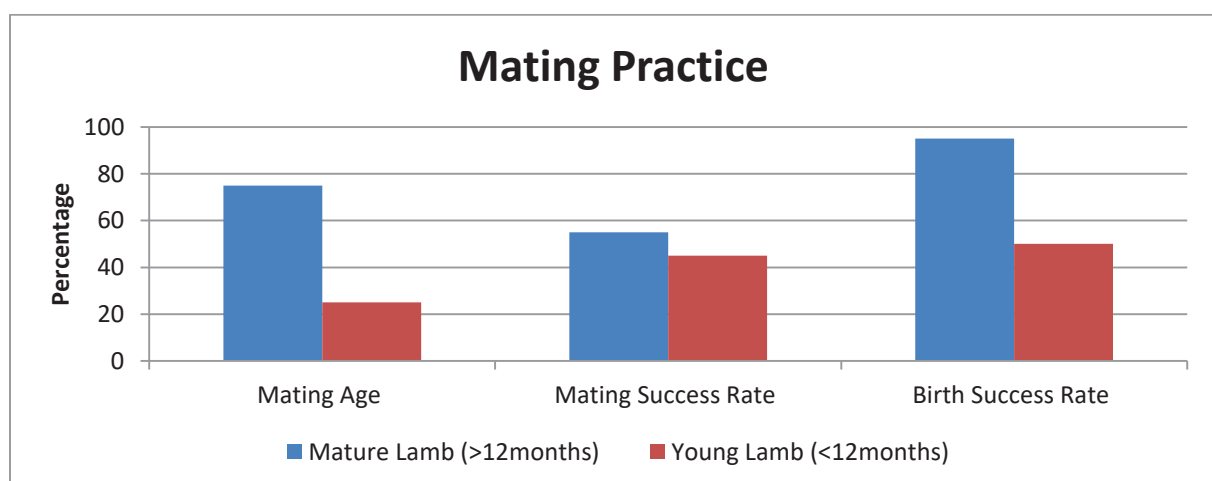


Figure 6: Mating practice

The results in Figure 6 indicate that 75% of the farmers mated their ewes at the mature age of 12 months or older, while 25% mated their ewes at a young age. Fifty-five percent of the farmers who mated their ewes at the mature age had a 95% birth rate; while 45% of farmers mated their ewes at a young age had a less than 50% birth rate.

Furthermore, the farmers who mated the ewes at a later age obtained better pregnancy rates as opposed to farmers who mated the ewes at a very early age. Mating age plays an important role in the reproduction of the ewes as this affects the number of lambs and multiple lambs born. It is apparent that most of the farmers do not have good management production systems (Khapayi & Celliers, 2016). The results indicate that mating age practice is one of the constraints experienced in sheep production systems by small-scale farmers.

Table 7 indicates that thirty farmers farmed with Merino sheep, three farmers with Dormers, two with Dorpers, and five farmers were not sure which sheep breed they are farming with. The results illustrate that the majority of farmer's surveyed farm with Merino sheep, probably because of wool prices being relatively high and the breed's ability to adapt in the study area.

Table 7: Different sheep breeds of study group

Category		Frequency
Breed	Dorpers	2
	Dormers	3
	Merino	30
	Unsure	5

4.4.2 Nutritional management

According to Pugh (2016), the economical and efficient production of sheep for meat, wool, show, and/or pets is contingent on proper feeding, husbandry practices, and health care. All of these are influenced by dietary intake. Maintenance of breeding animals, a high percentage of the lamb crop weaned, growth of lambs, optimal weaning weights, and a heavy fleece weight and fleece quality are important to efficiency. The nutritional requirements for maintenance, reproduction, growth, finishing, and wool production are complex because sheep are maintained under a wide variety of environmental conditions; however, attempts should be made to ensure each production unit or individual sheep has adequate nutrient intake to be healthy and productive. Table 8 provides an indication of the supplementary feeding practices of the respondents.

Table 8: Number of respondents using supplementary feeding during and after pregnancy

Number of famers using supplementary feeding two to six weeks after lambing	Type of supplementary feeds
23 farmers (57.5%) used supplementary feeding for ewes two to four weeks before and after lambing	Lucerne and salt
17 (42.5%) farmers only gave supplementary feeds after lambing for four weeks	Lucerne and salt

The results in Table 8; indicate that all the respondents provided supplementary feeding for ewes two to six weeks after lambing. However, only 23 farmers (57.5%) used supplementary feeding for ewes two to four weeks before and after lambing, while 17 (42.5%) farmers only gave supplementary feeds after lambing for four weeks. All the farmers surveyed fed lucerne and licks as supplementary feeds to ewes that had lambed. Livestock farming under unfavourable conditions often necessitates the use of supplementary feeding as it may increase the nutrient intake of grazing ruminants and correct deficiencies in pastures (De Waal, 1990). Pugh (2016), agreed that the use of supplementary feeding results in higher lambing rates with its associated increased survival rate. This is evident in those farmers that adequately supplied supplementary feed. Supplementary feeding is thus one of the more effective methods to improve livestock production. The results indicate that it is evident that nutritional management is one of the main constraints experienced in sheep production systems by small-scale farmers.

4.4.3 Support services

Raphela (2013) argued that farmers benefit from support services such as workshops, conferences, and membership of agricultural associations. Attendance of conferences and seminars provides an opportunity for extensive sharing of information about opportunities and production possibilities that are available, and workshops must be practical and relevant to the challenges they face rather than being too theoretical.

Agricultural information usually reaches rural farmers via extension workers, community libraries, radio, television, films, agricultural pamphlets, and state and local government agricultural agencies (Nnenna & Obadike, 2011). Respondents were requested to provide

information of the sources of information used and types of support received of which is summarised in Table 9.

Table 9: Source of information and support

Source of information and support	Frequency	Accumulative Percentage (%)
DoA	18	45.0
Agents connected to a cooperative	4	55.0
Agricultural magazines	4	65.0
Stud consultant	4	75.0
DoA / Agents connected to cooperative	2	80.0
DoA / Agricultural magazines	3	87.5
Agents / Stud consultant	2	92.5
DoA / Agents / Agricultural magazines	2	97.5
All	1	100.0
Total	40	-

Table 9 indicates that 45% of the respondents considered the Department of Agriculture (DoA) as the most important source of information for sheep farming. The results indicate that inadequate support services from government is one of constraints experienced in sheep production systems by small-scale farmers. Agents connected to cooperatives, agricultural magazines, and breed consultants were rated as the second most important sources of information with 55%, 65%, and 75% respectively. Agricultural extension can play a role in increasing methods to access of information for support services.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The emergent agricultural sector in South Africa has the potential to contribute to the growth of rural areas, and the reduction of unemployment, poverty, and inequalities. The potential of emerging farmers to participate in this sector is, however, untapped. Small-scale farmers do not participate in markets that yield high returns. In order for small-scale farmers to contribute to rural development, the abovementioned aspects need to be addressed effectively and determine constraints experienced in sheep production systems by these small-scale farmers. The study identified five specific challenges for small-scale farmers in the area. These were low education levels and a lack of farming skills pertaining to livestock production; poor management skills in terms of nutritional and health management; high transportation costs; lack of market information; and poor delivery of support services from the government. These five specific challenges were used to determine the main management systems used by small-scale sheep farmers in the Maluti-a-Phofung Local Municipality located in the Eastern Free State.

The majority of the products produced by the farmers are sold to informal markets where they receive poor prices. Some of the farmers used more than one marketing channel. The distance to markets is an important factor as long distances to the market can be discouraging to farmers in terms of transportation costs.

The findings also showed that most respondents suffered from a lack of market information owing to a lack of communication, tools, and support services from the government and extension officers. The majority of the farmers relied on word of mouth, family, and own research for information regarding product prices, which in most cases was biased, inaccurate, and/or out dated. Marketing information is very important for the market participation of small-scale farmers. The availability of market information with regard to product prices can help farmers make informed decisions about the marketing channels in which they participate. Farmers with no access to market information often make poor decisions. This information indicates the gap in education and possible role agricultural extension can play in the improvement of management practices through education of farmers about the market information.

Agricultural production methods in particular are dynamic and require farmers to have access to information and being able to interpret information. When people are uneducated, they may

become victims of being cheated and once people are cheated, they may refuse to adopt further innovations or change even if it benefits them. The majority of the farmers in the present study had low levels of education and skills.

5.2 Recommendations

Many limiting factors that affect Eastern Free State small-scale farmers' management of sheep production systems were discussed in this thesis. The main factors were the farmers' low educational levels that affect their comprehension of the dynamics of agriculture, poor management, lack of farming skills, high transportation costs to formal markets, poor market information, insufficient support services from the government, and a lack of farming equipment. The latter was evident as 50% of the farmers did not possess the most basic farming equipment and therefore the most basic activities could not be undertaken. The DoA needs to take a leading role in investing in support services, access to productive land, production inputs, extension services, and value-adding facilities to stimulate the farmers' participation in remunerative agricultural markets. Finally, the study recommends that the government must host planned workshops for all farmers in order to equip them with knowledge. Some agricultural bodies, such as the Red Meat Producers Organization (RPO), NWGA, and breeders' societies, can play a meaningful role in the training of these farmers. In section 5.3 the role agricultural extension can play to improve the management of these sheep production systems will be highlighted.

5.3 Extension implications

There are many extension services provided by either extension officers from the Department of Agriculture or the private sector around the study area, however, it is evident that there is a gap in the technical knowledge of the small-scale farmers. Extension officers are particularly well positioned and can play a significant role in distributing information from this study to small-scale farmers. It is obvious from the study that frequent intensive educational programmes are required to assist farmers in decreasing and closing the gaps identified in this study.

Farmers should be trained to understand their product in terms of aspects that significantly affect price. These include, amongst others, the animals' weight, condition (grading), age, and characteristics of wool at the marketing stage. The DoA needs to consider support policies and regulations to stimulate growth among farmers. The market participation of emerging farmers must be improved through encouraging group marketing, the upgrading of roads to enable easy access to markets, and livestock auctioneers should be motivated by means of

an incentive system to conduct auctions in the rural areas. Extension officers and farmers can be empowered by attending workshops as well as agricultural shows (such as NAMPO), having group discussions, and taking short courses offered by universities.

REFERENCES

- AFENYO, J.S. 2013. *Making Small-scale Farming Work in Sub-Saharan Africa*. [Online]. Available at: http://www.fao.org/fileadmin/user_upload/fsn/docs/Making_Small_Scale_Farming_Work_in_SSA_-_By_Joy_S._Afenyo.pdf.
- AFRICAN DEVELOPMENT BANK. 2015. *African Development Report 2015*. [Online]. Available at: <https://www.afdb.org/en/knowledge/publications/african-development-report/african-development-report-2015/>.
- AINA, L.O. 2007. *Globalisation and Small-scale Farming in Africa: What Role for Information Centres?* World Libraries and Information Congress, 73rd IFLA General Conference and Council. Durban, South Africa Development, on behalf of the Presidency. Pretoria: Government of the Republic of South Africa.
- ALIBER, M. & HALL, R. 2010a. *The Case for Re-strategizing Spending Priorities to Support Small-scale Farmers in South Africa*. [Online]. Available at: <http://www.plaas.org.za/plaas-publication/wp-17>.
- AYYAD, M.A. 2003. Case studies in the conservation of biodiversity: Degradation and threats. *Journal of Arid Environments* 54: 165-182.
- BAKER, J.K. & GREER, W.J. 1980. *Animal Health: A Layman's Guide to Disease Control*. Danville, Illinois: Interstates Printers and Publishers.
- BARBER, A. & FREEMAN, R.B. 2007. Design of sheep yards and shearing sheds. In *Livestock Handling and Transport* (3rd ed.), edited by T. Grandin. Wallingford, UK: CABI International. pp. 175-183.
- BEZUIDENHOUT, A.G. 1987. Intensiewe merinoskaapboerdery op besproeiingslande. *Karoo Agric* 3(7): 13-14.
- BOANDL, F.E. 1989. Effect of handling, administration of a local anesthetic and electrical dehorning on plasma cortisol in Holstein calves. *Journal of Dairy Science* 72: 2193-2197.
- BOTREAU, R., VEISSIER, I., BUTTERWORTH, A., BRACKE, M.B.M. & KEELING, L.J. 2007. Definition of criteria for overall assessment of animal welfare. *Animal Welfare* 16: 225-228.
- BRISKE, D.D., DERNER, J.D., BROWN, J.R., FUHLENDORF, S.D., TEAGUE, W.R., HAVSTAD, K.M., GILLEN, R.L., ASH, A.J. & WILLMS, W.D. 2008. Rotational grazing on rangelands: Reconciliation of perception and experimental evidence. *Rangeland Ecology & Management* 61: 3-17.
- BRAND, R.F., BROWN, L.R. & DU PREEZ, P.J. 2011, 'The Grassland vegetation of Platberg, eastern Free State, South Africa', *Koedoe* 53(1), Art. #1027, 13 pages. <http://dx.doi.org/10.4102/koedoe.v53i1.1027>
- CAMPBELL, A.C., BARON, V.S. & ARVID, A. 2003. *Alberta Agriculture and Rural Development*. [Online]. Available at: [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex12422](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex12422).

- CRONJÉ, G.J., DU TOIT, G.S., MOL, A.J., VAN REENEN, M.J. & MOTLATLA, M.D.C. 1997. *Introduction to Business Management* (4th ed.). Johannesburg: International Thompson Publishing.
- DEBLITZ, C. & ZIMMER, Y. 2007. *Agri Benchmark Beef: A standard operating procedure to define typical farms*. Braunschweig: Accessed 26 July 2018. http://www.agribenchmark.org/beef_typical_farms_definitions.html
- DALTON, C. 2009. *Introduction to Practical Animal Breeding*. Oxford: Blackwell.
- DELGADO, C.L., ROSEGRANT, M., STEINFELD, H., EHUI, S. & COURBOIS, C. 1999. *Livestock to 2020: The Next Food Revolution*. Food, Agriculture and the Environment Discussion Paper 28. Rome: FAO.
- DELGADO, C.L. & SIAMWALLA, A. 1997. *Rural Economy and Farm Income Diversification in Developing Countries*. Washington, D.C.: Markets and Structural Studies Division International Food Policy Research Institute.
- DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES (DAFF). 2012. *A Framework for the Development of Smallholder Farmers through Cooperatives Development*. Pretoria: Government Printers.
- DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES (DAFF). 2012. *A profile of the South African mutton market value chain*. Pretoria: Government Printers.
- DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES (DAFF). 2014. *A South African Wool Value Chain Profile*. Pretoria: Government Printers.
- DEVELOPMENT BANK OF SOUTHERN AFRICA (DBSA). 1986. *Policy Guidelines in Respect of Farmer Support Programmes*. Halfway House: DBSA.
- DE WAAL, H.O. 1990. Animal production from native pasture (veld) in the Free State region: A perspective of the grazing ruminant. *South African Journal of Animal Science* 20(1): 1-9.
- DUCROT, C., BED'HOM, B., BERINGUE, V., COULON, J.P., FOURICHON, C., GUERIN, J.L., KREBS, S., RAINARD, P., SCHWARTZ-CORNIL, I., DIDIER, T., VAYSSIER-TAUSSAT, M., ZIENTARA, S., ZUNDEL, E. & PINEAU, T. 2011. Issues and special features of animal health research. *Veterinary Research* 42: 96.
- FOOD AND AGRICULTURAL ORGANIZATION (FAO). 2004. *Livestock Sector Brief*. [Online]. Available at: http://www.fao.org/ag/againfo/resources/en/publications/sector_briefs/lbsb_ECU.pdf.
- FOOD AND AGRICULTURAL ORGANIZATION (FAO). 2005. *Country Pasture/Forage Resource Profiles – South Africa*. [Online]. Available at: <http://www.fao.org/ag/AGP/AGPC/doc/counprof/southafrica/southafrica.htm>.
- FOOD AND AGRICULTURE ORGANIZATION (FAO). 2009a. *Importance of the Livestock Sector*. [Online]. Available at: <ftp://ftp.fao.org/docrep/fao/012/i1034e/i1034e02.pdf>.

FOOD AND AGRICULTURE ORGANIZATION (FAO). 2009b. *Livestock Keeper: Guardians of Biodiversity*. Animal Production Health Paper no. 167. [Online]. Available at: <ftp://ftp.fao.org/docrep/fao/012/i1034e/i1034e00.pdf>.

FOOD AND AGRICULTURE ORGANIZATION (FAO). 2011. *World Livestock 2011: Livestock in Food Security*. Rome: FAO.

FREEMAN, H.A., KAITIBIE, H.A., MOYO, S. & PERRY, P.D. 2008. *Designing Livestock Interventions for Emergency Situations in Southern Africa*. Nairobi, Kenya: ILRI.

GALAL, E.S.E. 1983. Sheep germplasm in Ethiopia. *UNEP/FAO Animal Genetic Resources Newsletter* 1: 4-12.

GEBREMEDHIN, B., HOEKSTRA, D. & JEMANEH, S. 2007. *Heading Towards Commercialisation? The Case of Live Animal Marketing in Ethiopia: Improving Productivity and Market Success*. IPMS OF Ethiopia Farmers Project Working Paper 5. Nairobi, Kenya: ILRI.

GOMBE, S.Y., SUANDI T.B., ISMI, A.I., ZOHARA, O. 2016. Extension Education's Role towards Community Empowerment in Nigeria: Issues, Challenges and Prospects. *Journal of Education & Social Policy* Vol. 3, No. 2; June 2016.

GIPSON, T.A., MERKEL, R.C. & YAMI, A. (Eds.). 2007. *Selecting Breeding Stock for Sheep Production*. [Online]. Available at: <http://www.esgpip.org/PDF/Technical%20bulletin%20No.%204.pdf>.

GOLDBLATT, A. 2013. *WWF: Agriculture: Facts & Trends South Africa*. [Online]. Available at: <https://www.agrisa.co.za/wwf-agriculture-facts-and-trends-south-africa/>.

GORDON, R., MCDERMOTT, L., STEAD, M. & ANGUS, K. 2006. The effectiveness of social marketing interventions for health improvement: What's the evidence? *Journal of Business Ethics* 54: 33-50.

GOVERNMENT COMMUNICATIONS SOUTH AFRICA. 2012. *Pocket Guide to South Africa (2012/2013)*. [Online]. Available at: <http://www.gcis.gov.za/content/resourcecentre/sa-info/pocket-guide-south-africa-20122013>.

GREENBERG, S. 2010. *Status Report on Land and Agricultural Policy in South Africa, 2010*. Cape Town: Institute for Poverty, Land and Agrarian Studies, School of Government, University of the Western Cape.

GROSS, W.B. & SIEGEL, P.B. 1982. Influence or sequences or environmental factors on the response of chickens to fasting and to *Staphylococcus aureus* infection. *American Journal of Veterinary Research* 43: 137-139.

GUNNARSON, S. 2004. Definition of health and disease in textbooks of veterinarian medicine. Animal production in Europe: The way forward in a changing world. In *Proceedings of the 13th International Society of Animal Hygiene*. France: Saint-Malo. pp. 105-109.

HAN, G., HAO, X., ZHAO, M., WANG, M., ELLERT, B.H., WILLEMS, W. & WANG, M. 2008. Effect of grazing intensity on carbon and nitrogen in soil and vegetation in a meadow steppe in Inner Mongolia. *Agriculture, Ecosystems & Environment* 125: 21-32.

- HEMITO, D. 2009. Management for proper range use. *Technical Bulletin* No. 25. [Online]. Available at: <http://www.esgpip.org/PDF/technical%20bulletin%20no.25.pdf>.
- HO, P. & AZADI, H. 2010. Rangeland degradation in North China: Perceptions of pastoralists. *Environmental Research* 110: 302-307.
- HOFMEYR, J.H. 1976. Breeding policies and progress in relation to wool and meat production in the Republic of South Africa. *Proceedings of the Australian Society of Animal Production* (1976)11: 517-525.
- HUTSON, G.D. 2007. Behavioural principles of sheep handling. In *Livestock Handling and Transport* (3rd ed.), edited by T. Grandin. Wallingford, UK: CABI Publishing. pp. 155-174.
- HYBU CIG CYMRU (HCC) MEAT PROMOTION WALES. 2004. *Practical Sheep Breeding*. [Online]. Available at: <http://hccmpw.org.uk/medialibrary/publications/Practical%20Sheep%20Breeding%20E.pdf>.
- INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). 2007. *Climate Change: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge and New York: Cambridge University Press.
- JOHNSON, K.A. 1997. *Nutritional Management of Sheep Flock*. USA: Department of Animal Sciences Washington State University.
- JOHNSON, M.H. 2007. *Essential Reproduction* (7th ed.). USA: Wiley.
- JONES, R.B. & HUGHES, B.O. 1981. Effects of regular handling on growth in male and female chicks of broiler and layer strains. *British Poultry Science* 22: 461-465.
- JOUBERT, R. 2013. The skills needed to make SA farming more profitable. *Farmers Weekly*, 16 August. Available at: <https://www.farmersweekly.co.za/agri-business/agribusinesses/the-skills-needed-to-make-sa-farming-more-profitable/>
- KHANVILKAR, A.V., SHEJAL, M.A. & RAHANE, S. 2009. *Breeding Practices in Sheep Farming*. [Online]. Available at: https://www.researchgate.net/publication/49607955_Breeding_Practices_in_Sheep_Farming.
- KHAPAYI, M.I. & CELLIERS, P.R. 2016. Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape province, South Africa. *South African Journal of Agricultural Extension* 44(1): 25-41.
- KILGOUR, R.J., WATERHOUSE, T., DWYER, C.M. & IVANOV, I.D. 2008. Farming systems for sheep production and their effect on welfare. *The Welfare of Sheep*, edited by C.M. Dwyer. Nottingham, United Kingdom: Springer. pp. 213-265
- KINGWILL, G. 2011. Wool industry challenges and opportunities. *Merino Focus* 2011: 40-42.
- KIRSTEN, J. & VAN ZYL, J. 1998. Definition of small-scale farmers in the South African context. *Agrikon* 38: 560-571.

- KRAAIJ, T. & WARD, D. 2006. Effects of rain, nitrogen, fire and grazing on tree recruitment and early survival in bush-encroached savannah, South Africa. *Plant Ecology* 186: 235-246.
- KREUTER, U.P. & WORKMAN, J.P. 1997. Comparative profitability of cattle and wildlife ranches in semi-arid Zimbabwe. *Journal of Arid Environments* 35: 171-187.
- KRUGER, A.C. & SHONGWE, S. 2004. Temperature trends in South Africa: 1960-2003. *International Journal of Climatology* 24(15): 1929-1945.
- KUMAR, N.P. 2011. *Manual Operations in Farming*. Geneva: ILO.
- LAND TRANSPORT OF SHEEP STANDARDS AND GUIDELINES (LTSSG). 2011. *The Australian Standards and Guidelines for the Welfare of Animals*. Livestock Transport version 1.1 26. Australia: LTSSG.
- LEVIA, D.F. 1999. Synopsis: Land degradation: Why is it continuing? *AMBIO: A Journal of the Human Environment* 28(2): 200-201.
- LANDMAN, A.M.M. 2013. Economic Analysis of Intensive Sheep Production Systems in Central South Africa. (M.Sc. Agric). University of the Free State Bloemfontein.
- LOHMANN, D., FALK, T., GEISLER, K., BLAUM, N. & JELTSCH, F. 2014. Determinants of semi-arid rangeland management in a land reform setting in Namibia. *Journal of Arid Environments* 100/101: 23-30.
- LOUW, L. 2012. *Ekonomies belangrike aspekte van Angorabokboerdery*. Available at: www.gadi.agric.za.
- LOUW, A., CHIKAZUNGA, D., JORDAN, J. & BIENABE, E. 2007. *Regoverning Markets: Small-scale Producers in Modern Agrifood Markets*. Agrifood Sector Series: Restructuring Food Markets in South Africa: Dynamics within the Context of the Tomato Sub-sector. Pretoria: University of Pretoria.
- MAKAPELA, J. 2009. An Overview of the Management Practices for Wool Production amongst the Communal Farmers of the HEWU District in the Eastern Cape Province. (Master's thesis). Nelson Mandela Metropolitan University, Port Elizabeth.
- MAKHURA, T.M. 2001. Overcoming Transaction Costs Barriers to Market Participation of Smallholder Farmers in the Northern Province of South Africa. (PhD dissertation). University of Pretoria, Pretoria.
- MANGISONI, J. 2006. *Markets, Institutions and Agricultural Performance in Africa*. ATPS Special Paper Series No. 27. Nairobi, Kenya: African Technology Policy Studies Network.
- MAPONYA, P. & MPANDELI, S. 2012. Climate change and agricultural production in South Africa: Impacts and adaptation options. *Journal of Agricultural Science* 4: 48-60.
- MAREE, C. & CASEY, N.H. 1993. *Livestock Production Systems*. Brooklyn: Agri-Development Foundation.

- MARK, C. & ROOT, T. 2006. *Mineral nutrition of livestock* (4th ed.). [Online]. Available at: http://www.ucv.ve/fileadmin/user_upload/facultad_agronomia/Produccion_Animal/Minerals_in_Animal_Nutrition.pdf.
- MARTIN, G.B., MILTON, J.T., DAVIDSON, R.H., BANCHERO HUNZICKER, G.E., LINDSAY, D.R. & BLACHE, D. 2004. Natural methods for increasing reproductive efficiency in small ruminants. *Animal Reproductive Science* 82/83: 231-245.
- MCGRANAHAN, D.A. & KIRKMAN, K.P. 2013. Multifunctional rangeland in southern Africa: Managing for production, conservation, and resilience with fire and grazing. *Land* 2: 176-193.
- MENKE, K.H. & STEINGASS, H. 1988. Estimation of the energetic feed value obtained from chemical analysis and in vitro gas production using rumen fluid. *Animal Research Development* 28: 7-55.
- MONTSHWE, B.D. 2006. Factors Affecting Participation in Mainstream Cattle Markets by Small-scale Cattle Farmers in South Africa. (M.Sc. Agric dissertation). University of Free State, Bloemfontein.
- MORAN, C. 2014. *Preparing for the Breeding Season on Sheep Farms*. [Online]. Available at: <http://www.agriland.ie/farming-news/preparing-breeding-season-sheep-farms/>.
- MUNYAI, F.R. 2012. An Evaluation of Socio-economic and Biophysical Aspects of Small-scale Livestock Systems Based on a Case Study from Limpopo Province: Muduluni Village. (PhD dissertation). University of the Free State, Bloemfontein.
- NATIONAL WOOL GROWERS ASSOCIATION (NWGA). 2012. *National Wool Growers Association (NWGA) Report for the period 1 July 2011 – 30 June 2013*. South Africa: NWGA.
- NEARY, M. 1992. *Management of Ewes and Suckling Lambs from Birth to Weaning*. [Online]. Available at: <ftp://ftp.fao.org/docrep/fao/010/x6542e/x6542e08.pdf>.
- NEARY, M. 2013. *Reproductive Management of the Ewe Flock and the Ram*. [Online]. Available at: <http://ag.ansc.purdue.edu/sheep/articles/repromgt.html>.
- NEL, C., VAN PLETZEN, H. & GROENEWALD, I. 2010. *Skaapproduksie op Meerjarige Besproeide Weidings*. [Online]. Available at: <http://www.landbou.com/wp-content/uploads/2014/03/2301eb7c-01b4-4321-b236-e806f79d2ffa.pdf>.
- NNENNA, A. & OBADIKE, A. 2011. Rural farmers' problems accessing agricultural information: A case study of Nsukka Local Government Area of Enugu State, Nigeria. *Library Philosophy and Practice* 20(1): 40-43.
- NTHAKHENI, N.D. 2006. A livestock production system study amongst resource poor livestock owners in Vhembe District of Limpopo Province. Degree of Doctor of Philosophy at the University of the Free State.
- NORDBLOM, J.L. & SHOMO, F. 1995. *Food and Feed Prospects to 2020 in the West Asia North Africa Region*. ICARDA Social Science Paper No. 2. Aleppo, Syria: International Centre for Agricultural Research in the Dry Areas.

NORDQUIST, R.E., VAN DER STAAY, F.J., VAN EERDENBURG, F.J., VELKERS, F.C., FIJN, L. & ARNDT, S.S. 2013. *Mutilating Procedures, Management Practices, and Housing Conditions that may Affect the Welfare of Farm Animals: Implications for Welfare Research*. [Online]. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28230800>.

NTSHEPE, L. 2011. Marketing Information Needs of Smallholder Livestock Farmers in the Moretele Area in the Bojanala Platinum District Municipality of the North West Province. (Master's thesis). University of South Africa, Pretoria.

NYAM, S. 2017. A Metafrontier Analysis of Sheep Production in the N8 Development Corridor. (Master's thesis). University of the Free State, Bloemfontein.

OBIDIKE, N.A. 2011. *Rural Farmers' Problems Accessing Agricultural Information: A Case Study of Nsukka Local Government Area of Enugu State, Nigeria*. Available at: <https://digitalcommons.unl.edu/libphilprac/660/>.

OWOMBO, P.T., AKINOLA, A.A., AYODELE, O.O. & KOLEDIOYE, G.F. 2012. Economic impact of agricultural mechanization adoption: Evidence from maize farmers in Ondo State, Nigeria. *Journal of Agriculture and Biodiversity Research* 1(2): 25-32.

PALMER, A.R., AINSLIE, A.M. & HOFFMAN, M.T. 1999. Sustainability of commercial and communal rangeland systems in southern Africa. In *Proceedings of the 6th International Rangeland Congress*. Townsville, Australia, 17-23 July.

PENN STATE COLLEGE OF AGRICULTURAL SCIENCES. 2017. *Marketing Meat Animals Directly to Consumers*. [Online]. Available at: <https://extension.psu.edu/courses/beef/marketing/marketing-meat-animals-directly-to-consumers>.

POGGENPOEL, D.G. & VAN DER MERWE, C.A. 1987. Selection response with index selection in three commercial Merino flocks. *South African Journal of Animal Science* 17: 70.

PUGH, D.G. 2016. *Overview of Nutrition: Sheep*. Alabama: Department of Pathobiology, College of Veterinary Medicine, Auburn University. [Online]. Available at: <http://www.msdsvetmanual.com/management-and-nutrition/nutrition-sheep/overview-of-nutrition-sheep>

RANDELA, R. 2005. Integration of Emerging Cotton Farmers into the Commercial Agricultural Economy. (PhD dissertation). University of the Free State, Bloemfontein, South Africa.

RAPHELA, M.G. 2014. Smallholder Farmers in Ekurhuleni: The Challenges and Constraints of Access to Agricultural Markets. (Master's thesis). Stellenbosch University, Stellenbosch.

RICKETTS, D. 1993. Restorative dentistry: Management of the deep carious lesion and the vital pulp dentine complex. *British Dental Journal* 191: 606-610.

RICKETTS, T.C. (Ed.). 1999. *Rural Health in the United States*. New York: Oxford University Press.

SACHSE, J.M. 2012. Sheep production and management: Influence of Sire Breed, Protein Supplementation and gender on wool spinning fineness in First-Cross Merino Lamb. *World Academy of Science, Engineering and Technology: International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering* 6(7): 460-467.

SALAMI, A., KAMARA, A.B. & BRIXIOVA, Z. 2010. *Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities*. Working Paper Series. Tunis: African Development Bank.

SALEM, H. 2010. Nutritional management to improve sheep and goat performances in semiarid regions. *Revista Brasileira de Zootecnia* 39: 337-347.

SALEM, H. & SMITH, T. 2008. Feeding strategies to increase small ruminant production in dry environments. *Small Ruminant Research* 77: 174-194.

SASKATCHEWAN MINISTRY OF AGRICULTURE. 2008. *Grazing management for sheep production*. Available at: <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/livestock/cattle-poultry-and-other-livestock/sheep-and-goats/grazing-management-for-sheep-production>.

SAS INSTITUTE INC. 1999. *SAS/STAT User's Guide, Version 9: Volume 2*. North Carolina: SAS Institute Inc.

SCHICHOWSKI, S., MOORS, E. & GAULY, M. 2008. Effects of weaning lambs in two stages or by abrupt separation on their behavior and growth rate. *Journal of Animal Science* 86(1): 220-225.

SCHOENIAN, S. 2011. *A Beginner's Guide to Raising Sheep*. [Online]. Available at: <http://www.sheep101.info/201/>.

SCOTT, P. 2011. *Sheep Management Schedule*. [Online]. Available at: <http://pubs.ext.vt.edu/410/410-365/410-365.pdf>.

SMET, M. & WARD, D. 2006. Soil quality gradients around water points under different management systems in a semi-arid savannah, South Africa. *Journal of Arid Environments* 64: 251-269.

SMITH, B. 2006. *The Farming Handbook*. Scottsville: University of Kwazulu-Natal Press.

SMITH, M. 2004. Aangeplante weiding bly betalend. *Landbouweekblad*, 30 July.

SNYMAN, H.A. 1998. Dynamics and sustainable utilization of rangeland ecosystems in arid and semi-arid climates of South Africa. *Journal of Arid Environments* 39: 645-666.

SOLLENBERGER, L.E., VENDRAMINI, J.M.B. & NEWMAN, Y.C. 2009. *Grazing Management Concepts and Practices*. Florida: University of Florida.

SPEDDING, C.R.W. 1988. General aspects of modelling and its application in livestock production. In: Korver S and van Arendonk JAM (Eds). *Modelling livestock Production systems*, 3-9. Kluwer Academic Publishers.

STATISTICS SOUTH AFRICA (STATS SA). 2011. *Census 2011: Agricultural Households*. Pretoria: Stats SA.

STATISTICS SOUTH AFRICA (STATS SA). 2013. *Mid-year Population Estimates 2013*. Pretoria: Stats SA.

STATISTICS SOUTH AFRICA (STATS SA). 2016. *Community Survey: Agricultural households*. Pretoria: Stats SA.

STEINFELD, H., GERBER, P., WASSENAAR, T., CASTEL, V., ROSALES, M. & DE HAAN, C. 2006. *Livestock's Long Shadow: Environmental Issues and Options*. Rome: FAO.

SWANEPOEL, F.J.C. & MOYO, S. 2010. Multifunctionality of livestock in developing communities. In *The Role of Livestock in Developing Communities: Enhancing Multi-functionality*, edited by F.J.C. Swanepoel, A. Stroebel & S. Moyo. Wageningen, The Netherlands: CTA. pp. 87-100.

TEFERA, S., DLAMINI, B.J. & DLAMINI, A.M. 2010. Changes in soil characteristics and grass layer condition in relation to land management systems in the semi-arid savannas of Swaziland. *Journal of Arid Environments* 74: 675-684.

TESFAYE, T. 2009. Characterization of Goat Production Systems and On-farm Evaluation of the Growth Performance of Grazing Goats Supplemented with Different Protein Sources in Metema Woreda, Amhara Region, Ethiopia. (Master's thesis). Haramaya University, Haramaya, Ethiopia.

TESSEMA, Z.K., DE BOER, W.F., BAARS, R.M.T. & PRINS, H.H.T. 2011. Changes in soil nutrients, vegetation structure and herbaceous biomass in response to grazing in a semi-arid savannah of Ethiopia. *Journal of Arid Environments* 75: 662-670.

THOMAS, K. 2012. *Strategies for a Profitable and Competitive Sheep Production System*. Available at: http://www.ansci.wisc.edu/extension-new%20copy/sheep/Publications_and_Proceedings/Pdf/Management/Strategies%20for%20a%20profitable%20and%20competitive%20sheep%20production%20system.pdf

THOMPSON, J. 2006. *Sheep Production Guide*. [Online]. Available at: <https://catalog.extension.oregonstate.edu/em8916>.

THORNTON, P.K. 2010. Livestock production: Recent trends, future prospects. *Philosophical Transactions of the Royal Society of London* 365(1554): 2853-2867.

VAN DER WESTHUIZEN, H.C., SNYMAN, H.A. & FOUCHÉ, H.J. 2005. A degradation gradient for the assessment of rangeland condition of a semi-arid sourveld in southern Africa. *African Journal of Range and Forage Science* 22: 47-58.

VAN DER ZIJPP, A., WILKE, P. & CARSAN, S. 2010. Sustainable livestock intensification. In *The Role of Livestock in Developing Communities: Enhancing Multi-functionality*, edited by F.J.C. Swanepoel, A. Stroebel & S. Moyo. Wageningen, The Netherlands: CTA. p. 123.

VAN NIEKERK, P.D.P. & TRUCKMAN, N. 2002. Product Development as Part of a Positioning Strategy for the Hunting Industry in the Eastern Cape. (PhD dissertation). Port Elizabeth Technikon, Port Elizabeth.

VAN ROOYEN, J. 2008. A short overview note in search of a paradigm? In *Proceedings of the Satellite Symposium on Role of Livestock in Developing Communities: Enhancing Multi-functionality*. Cape Town: South Africa. p. 3.

VAN SCHALKWYK, H.D., GROENEWALD, J.A., FRASER, G.C.G., OBI, A. & VAN TILBURG, A. 2012. *Unlocking Markets to Smallholders: Lessons from South Africa*. Mansholt Publication Series No. 10. The Netherlands: Mansholt Publications.

WARN, L. WARE, J.W., SALMON, L. DONNELLY, J. & ALCOCK, D. 2006. *Profitability of sheep enterprises in Southern Australia*. Available at: www.sheepcrc.org.

WARD, D., HOFFMAN, M.T. & COLLOCOTT, S.J. 2014. A century of woody plant encroachment in the dry Kimberley savannah of South Africa. *African Journal of Range and Forage Science* 31(2): 107-121.

WESSELS, H.W. 2011. 'n Ondersoek na die Ekonomiese Volhoubaarheid van Semi-intensiewe en Intensiewe Skaapboerdery in die Oostelike Hoëveld Streek van Suid-Afrika. (Master's thesis). University of the Free State, Bloemfontein.

WILLIAM, T. 2005. The extension sheep specialist. *The Original Manuscript of Sheep Production and Management* 86(11): 3252-3274.

WORLD BANK. 2008. *World Development Report*. Washington, D.C.: World Bank.

YAMI, A. & MERKEL, R.C. (Eds.). 2011. *Sheep and Goat Production Handbook for Ethiopia*. [Online]. Available at: https://issuu.com/esgpi/docs/esgpi_sheep_and_goat_handbook.

ZELALEM, T. 2007. Adoption of Small Ruminant Fattening Package in Agropastoral Areas, Meiso Wereda, Eastern Oromia. (Master's thesis). Haramaya University, Haramaya, Ethiopia.

ANNEXURES

Annexure A: Questionnaire

Questionnaire on the Assessment of Eastern Free State small scale farmers' management of sheep production systems

Richard Sankatane Mahlako

This questionnaire is part of a research based study for the obtainment/partial fulfilment of the
M. Tech/ Master's Degree in Agriculture
in the school for Agriculture and Environmental Sciences at
Central University of Technology, Free State
2016

Objectives of the study

The primary objective of this study is to investigate factors leading to poor sheep management of small emerging farmers in Eastern Free State, high rate of morbidity and mortality and increased cost of maintenance, the objective is to study the management practices followed in production of sheep, reproduction, nutrition, health management, marketing of sheep, health management and marketing strategies.

Instructions

NB: Please read the following instructions carefully in order to complete this questionnaire correctly;

- a) To protect the company's confidentiality, the producer need not to mention the name of his/her farm or of the organization where she/he manages the farm.
- b) The farmers or the farm managers should provide accurate information as far as possible.
- c) Mark with "X" where you have to choose and give reasons where applicable.

This questionnaire consists of 5 Sections, namely;

Section A :General Information

Section B :Reproduction and Production

Section C :Nutrition

Section D :Health management

Section E :Marketing of sheep

Section F :Equipment

Thank you for your time and effort for filling this questionnaire

Supervisor: Prof P. J. Fourie

Email: pfourie@cut.ac.za

School of Agriculture and Environmental Science

Central University of Technology, Free State

Dirk Coetzee Building

1 Park Road,

Bloemfontein

9300

South Africa

Tel : (051) 507 3113

Fax: (051) 507 3435

www.cut.ac.za

Questionnaire

For office
use only

1. Section A: General Information

1.1. Questionnaire number

1.2. Date of interview/...../.....

1.3 Gender

Choose one	
Male	
Female	

	2
	3

1.4 Age range

.....
...

	4
--	---

1.5 How long have you been farming

.....
...

	5
--	---

1.6 What is your major educational qualification obtained? (max. 3)

.....
...

	6
--	---

1.7 Race

Choose one	
Black	
White	
Other	

	7
	8
	9

1.8 If other, specify:

	10
--	----

1.9 Please indicate town where the farm is situated. (*Indicate*)

Choose one

Phuthaditjhaba	
Tshiyame	
Harrismith	
Clarens	
Reitz	
Ficksburg	
Ladybrand	
Winburg	
Senekal	
Bethlehem	
Warden	

	11
	12
	13
	14
	15
	16
	17
	18
	19
	20

1.10. How many hectares do you own for grazing of sheep?

.....ha

	21
--	----

1.11 Are you leasing any land in addition to above mentioned hectares?

Choose one	
Yes	
No	

	22
	23

1.12. If Yes, how many hectares are leased?

.....ha

	24
--	----

1.13. Which sheep breed are you farming with?
(Please indicate)

Choose one	
Dorper	
Merino	
Dorset	
Dorset	
Not sure	
If any other specify:	

	25
	26
	27
	28
	29
	30

1.14 What are the most important sources of information you are in your sheep farming?

Choose one	
Department of Agriculture	
Agents connected to a co-op	
Agricultural magazines	
Stud consultant	
If any, specify:	

	31
	32
	33
	34
	35

1.15 What do you see as the three most important problems which affect the efficiency of your sheep enterprise

Choose maximum three	
Lambing problems	
Poor veld conditions	
Theft	
Ewes have no milk or little milk during lambing season	
Diseases and diseases control	
Poor Management problems in lambing season	

	36
	37
	38
	39
	40
	41
	42

Section B: Reproduction and Production

2.1 At what age are ewes mated?

..... months

43

2.2 Do you identify multiple lambs?

Choose one	
Yes	
No	

44

45

2.3 Who does the selection of your young replacement ewes in your flock?

46

Choose one or more

I do it myself	
Extension officer	
Fellow famer	

47

48

49

If other, specify:

.....
.

50

2.4 Do you test the fertility of your rams before the mating season?

Choose one or more

I had clinical test done	
I had the reproductive organs examined by a vet before mating season	
I did self-examination (farmer)	
My rams usually do not have fertility problems	
No action was taken	

51

52

53

54

55

2.5 How frequently are ewes mated?

Choose one

Rams are continuously with ewes	
Once a year	
Three times a year	

56

57

58

2.6 If other, specify:

.....

59

2.7 How many rams do you use per 100 ewes?

.....

60

2.8 How do you prepare ewes for mating in a normal year?

Choose one or more

By providing extra feed a few weeks before mating
By putting ewes in rested camps
By putting ewes on cultivated pastures
All ewes are treated equally and no ewes receive extra feed.
No action is taken

<input type="checkbox"/>	61
<input type="checkbox"/>	62
<input type="checkbox"/>	63
<input type="checkbox"/>	64
<input type="checkbox"/>	65

2.9 For how long (in days) do you put your rams with ewes?

.....days

<input type="text"/>	66
----------------------	----

2.10 Which two months of the year are the best mating months in your area?

<input type="text"/>	67
----------------------	----

write in months .(1).....and
(2).....

<input type="text"/>	68
----------------------	----

2.11 How many ewes were ready to be mated previous year?

<input type="text"/>	69
----------------------	----

2.12 How many lambs were born alive?

<input type="text"/>	70
----------------------	----

2.13 How many lambs were sold?

<input type="text"/>	71
----------------------	----

2.14 Which lambing system(s) do you make use of?

Choose one or more

Ewes lamb in small pens	<input type="checkbox"/>
Ewes lamb in normal camps	<input type="checkbox"/>
Ewes lamb in small camps close to the house	<input type="checkbox"/>
Ewes lamb on cultivated pastures	<input type="checkbox"/>

<input type="checkbox"/>	72
<input type="checkbox"/>	73
<input type="checkbox"/>	74
<input type="checkbox"/>	75

2.15 How many ewes have lambed multiples in the past lambing season?

<input type="text"/>	76
----------------------	----

mated.

..... per 100 ewes

2.16 What is the main reason why ewes do not raise lambs?

Choose one or more

Ewes did not conceive and lamb	<input type="checkbox"/>
Lambs died shortly after birth	<input type="checkbox"/>

<input type="checkbox"/>	77
<input type="checkbox"/>	78

2.17 If any other, specify:

79

2.18 If you farm with wool sheep, how much wool did you sell the previous year ?

.....kg
.....bales

80
 81

2.19 How do you manage ewes that did not raise a lamb at least once a year?

Cull all ewes first time
Give ewes one opportunity to skip and then cull
Mark only some and cull the remaining
Replace it with mature ewe

82
 83
 84
 85

Section C: Nutrition

3.1 Do you provide extra feed to ewes in the late pregnancy stage?

Choose one

Yes	<input type="text"/>
No	<input type="text"/>

86
 87

3.2 If **Yes**, indicate period in weeks for 3.1?

.....weeks

88

3.3 What kind of feeds do you use for 3.1?

Choose one or more

Chocolate maize	<input type="text"/>
Maize	<input type="text"/>
Lucerne	<input type="text"/>
Feed pellets	<input type="text"/>
Rested veld	<input type="text"/>
Pastures	<input type="text"/>
Licks	<input type="text"/>

89
 90
 91
 92
 93
 94
 95

3.4 If any,
specify:.....

96

3.5 Do you give supplementary feeding to ewes that have lambed?

Choose one

Yes	<input type="text"/>
No	<input type="text"/>

97
 98

—

3.6 If **Yes**, please indicate the number of weeks these ewes get extra feed

.....weeks

 99

3.7 Which supplementary feeding do you give to ewes that have lambed

Choose one or more

chocolate maize	
Maize	
Lucerne	
feed pellets	
Rested veld	
Pastures	
Licks	

 100
 101
 102
 103
 104
 105
 106
 107

3.8 How much supplementary lick is available per ewe per day?

...../g

 108

Section D: Health management

4.1 Against which diseases do you vaccinate?

Choose one or more

Pulpy kidney	
Pasteurella	
Rift valley fever	
Blue tongue	
Sheep scab	
Blue udder	
Not sure	

 109
 110
 111
 112
 113
 114
 115

4.2 Which three of the following diseases normally causes the most mortalities?

Choose one or more

Pulpy kidney	
Pasteurella	
Rift valley fever	
Blue tongue	
Sheep scab	
Blue udder	
Not sure	

 116
 117
 118
 119
 120
 121
 122

4.3 Which external parasites do you normally dip/spray for ?

Choose one or more

Lice and mites	
Ticks	
Sheep blowfly	

 123
 124
 125

Karoo paralysis tick	
Not sure	

	126
	127

4.4 If any, specify:

.....

4.5 Do you test your rams for Brucella ovis?

Choose one

Yes	
No	

	128
	129

4.6 By whom was the rams tested for Brucella ovis?

Choose one or more

Veterinary surgeon	
Animal Health Technician	
Field Officer	
Farmer	

	130
	131
	132
	133
	134

4.7 How often do you dose sheep in a year?

.....times

	135
--	-----

4.8 Where do you buy breeding rams?

Choose one or more

It is supplied by the department of Agriculture	
Veld ram sales	
National sales	
From other farmers in the area	
Breed own lambs / keep best ram lambs	

	136
	137
	138
	139
	140

4.9 If any,

specify:.....

	141
--	-----

4.10 Why do you buy rams there?

.....

..

	142
--	-----

Section E: Marketing of sheep

5.1. Do you consider weight when marketing sheep?
(Indicate)

Choose one	
Yes	
No	

	143
	144

5.2. Where do you sell/market sheep? (Indicate)

Choose one or more	
Abattoir	
Feedlot	

	145
	146

Private people	
Other	

	147
	148
	149
	150

5.3. If other, specify:

.....

5.4. How do you get sheep being delivered to market?
(Indicate)

Choose one	
Own transport	
Hired transport	
Buyer's transport	

	151
	152
	153

5.5. What time/s of the year do you normally market the sheep and why specific time?

Month.....

Reason for the specific month.....

.....

...

	154
--	-----

5.6. If other, specify:

.....

	155
--	-----

5.7. How much is the average cost of transport per sheep to the market?

R..... per
sheep

	156
--	-----

5.8. Do you consider grouping sheep according to the following when you sell animals?

Choose one or more

Size	
Gender	
Breed	
Weight	

	157
	158

5.9. Give reason(s) for above-mentioned answer. (Explain).

.....

...

.....

..

	159
--	-----

.....
..

5.10 At what age (in months) do you market
your slaughtered lambs

.....Months

	16
	0

5.11 How do you market your wool?

BKB	
Via Agent	
CMW	

	16
1	16
2	16
3	16
4	16

5.12 If any, specify

Section F: Equipment

6.1 Indicate which of the following equipment
you have on the farm

Choose one or more

Dosing gun	
Syringe	
Bur disso	
Castrating ring applicator	
Aussie tag applicator	
Hoof shear	
Sheep shear (wool)	
If any other please specify:	

	16
5	16
6	16
7	16
8	16
9	16
17	17
0	17
1	17

Thank you

Annexure B: Article submitted to SA Journal of Agricultural Extension

Assessment of the management practices of emerging sheep production systems in the Eastern Free State: Can the extensionist make a difference?

P.J. Fourie[#], S.R. Mahlako & C. Van der Westhuizen

Department of Agriculture, Central University of Technology, Free State, Private Bag X20539, Bloemfontein
9300, South Africa

Abstract

The aim of the study was to investigate limiting factors that prevent small-scale farmers from succeeding. Poor sheep production is generally associated with the ineffective management of sheep production systems. It would therefore be valuable to assess small-scale farmers' management of sheep production systems to investigate what causes the high rate of morbidity and mortality and increased cost of maintenance associated with ineffective sheep production systems. The management practices followed in the production of sheep, including reproduction, nutrition, and health management; the management of farming equipment; and marketing strategies, were also investigated. Structured questionnaires were used to gather the required data from small-scale farmers in the Eastern Free State. The questionnaire was designed to include both open- and closed-ended questions, and was administered through personal interviews. Forty small-scale farmers participated in the study. The results revealed that the specific limiting factors that small-scale farmers face are poor animal health management skills, poor animal nutritional management, and inadequate support services from government and other related stakeholders. Furthermore, insufficient land availability to expand production, inadequate agricultural farming equipment, a lack of reproduction and production management skills, and poor marketing skills were the most obvious challenges. Finally, the results from the study highlighted that agricultural extensionists have a crucial role to play in improving the sheep production systems of small-scale farmers as they are well positioned to render training and advisory services. If the Department of Agriculture (DoA) joins forces with agricultural institutions like the Red Meat Producers Organization (RPO), the National Wool Growers Association (NWGA), and breeders' societies, this objective will be achieved.

Keywords: Emerging sheep farmer, sheep production, constraints, production systems, Eastern Free State

#Corresponding author: pfourie@cut.ac.za

4.1 Introduction

The information that follows resulted from a descriptive analysis of the data collected. The results are presented using descriptive statistics frequencies, counts, charts, percentages, and standard deviations. All respondents were interviewed on their farming area by appointment. Interviewing the respondents on their farming area permitted the researcher to observe their farming areas. The respondents were asked to motivate their answers to verify whether they understood what they were being asked. In this regard, all the results in the present study are assumed to be correct and valid.

The study used data collected from a sample of 40 emerging farmers using a questionnaire survey. All 40 farmers were engaged in livestock rearing; about 10 of whom were also engaged in crop production.

4.2 Demographics

Van Schalkwyk, Groenewald, Fraser, Obi and Van Tilburg (2012) identified variables such as location, age, education, access to credit, membership of farmers' union, market distance, and land size in their various studies on the challenges affecting smallholders in the country. In constructing a descriptive profile of smallholder farmers, some of the variables identified by Van Schalkwyk *et al.* (2012) were used in order to create a structured and comprehensive profile of the small-scale famers in the survey.

Similarly, Salami, Kamara and Brixiova (2010) identified variables such as land tenure and farm management, access to input and output markets, infrastructure, and institutional matters as key to small-scale famers' development, which were also considered in this research to build a profile of small-scale famers in the study area.

Figure 3 provides an indication of the ages of the respondents grouped into three categories namely 1) 15-34 years, 2) 35-64 years and 3) 65 years and older.

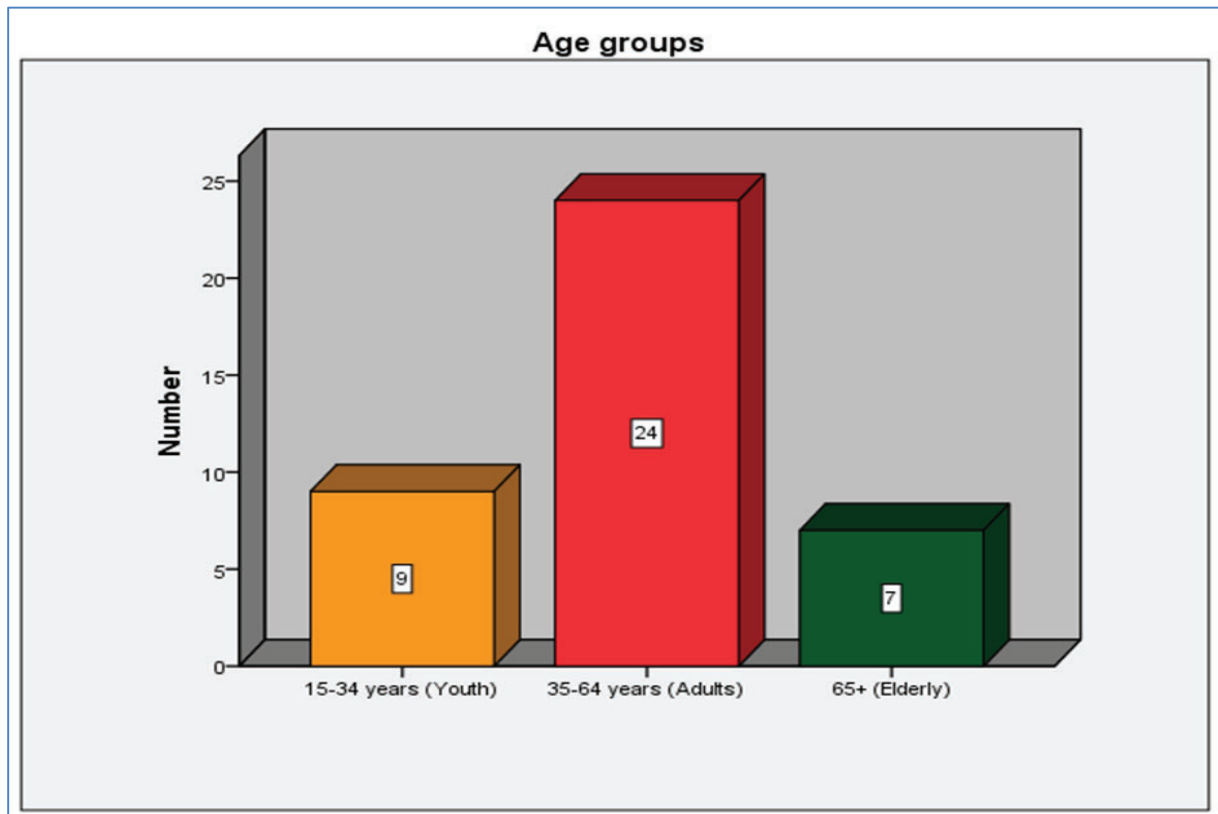


Figure 1: Age of the respondents

From Figure 3 it is evident that most of the farmers in this study were adults (24, or 60%, were aged 35-64 years), followed by nine youth (aged 15-34 years) farmers (22.5%). The figure also shows that only seven (17.5%) of the farmers were elderly people aged 65 years and older. The majority of the farmers were older than 40 years of age, which may be an indication that the younger generation prefers not to get involved in agricultural activities, particularly farming, but would rather migrate to urban areas in search of better salaries and jobs. Agricultural extension can play a role in educating the community about the benefits of agriculture. The aged participants also displayed the knowledge gained through the years by how they articulated their responses.

Of the 40 farmers who participated in the study, 35 (87.5%) were male and five (12.5%) were female. This indicates the general farming demographic of the region; Agricultural extension can play a role in educating more females about the benefits of agriculture.

According to Stats SA (2011), less than a quarter of South African households (22%) are involved in agricultural production, with those involved in agriculture engaged mostly in the production of food and grains (43.4%), fruit and vegetables (30.1%), poultry (43.9%), and livestock (49.4%). Most crop production takes place in backyard gardens (87.6%) According to Smet & Ward (2006), commercial livestock and game farming are managed by persons with secondary education and others with tertiary

education, while both these management systems also enjoy the support of South African agricultural research institutes.

Smet & Ward (2006) further indicated that communal livestock farming has been based mainly on traditional management systems, which are managed by individuals without any formal training in either animal husbandry or veld management. This situation is further complicated by no one person actually being in charge. Comparative findings relating to commercial ranching, communal livestock ranching, and game ranching management systems indicated that communal livestock ranches are expected to have a more detrimental effect on rangeland conditions than the other management systems because the stocking densities and, consequently, herbivore impacts, are usually far higher than under the other two management systems (Kreuter & Workman, 1997).

Table 4 provides an overview of the educational status of the respondents.

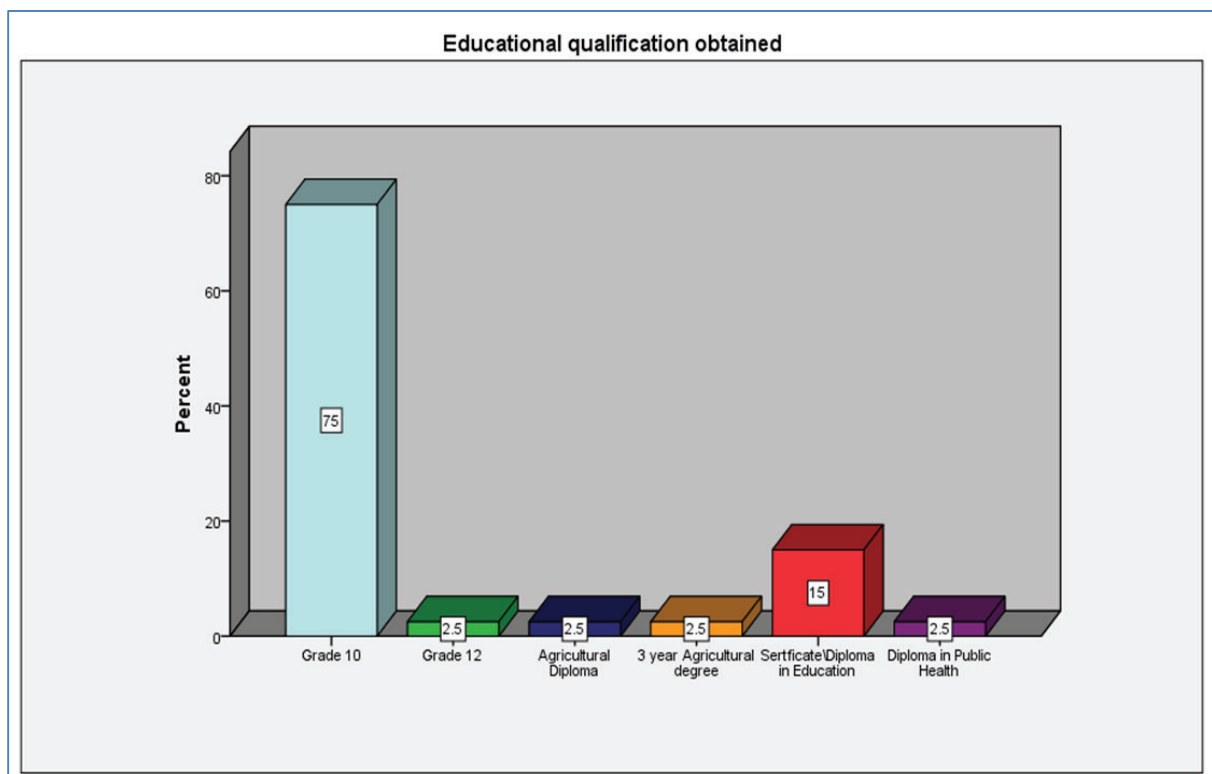


Figure 2: Educational status of the respondents

Figure 4 depicts that 75% of the farmers had completed Grade 10, 2.5% had completed Grade 12, 15% had a diploma or a three-year degree in Agriculture, 15% had a certificate/diploma in Education, and 2.5% had a diploma in Public Health. The majority of the farmers were therefore educated up to the end of high school. A business in general requires someone who is open-minded and who has the ability to quickly grasp concepts; a low level of agricultural education is one of main management challenges small-scale sheep production farmers encounter in the Eastern Free State. Agricultural education assists

with skills such as record keeping and banking skills, labour management, and the ability to choose a profitable enterprise and suitable production method(s) for that enterprise (Khapayi & Celliers, 2016). Agricultural production methods in particular are dynamic and require that farmers are knowledgeable and up to date with the latest developments and changes. Agricultural extension can play a role in increasing methods to access of information for support services.

4.3 The management challenges encountered by small-scale sheep production farmers in the study area

4.3.1 Farming experience

According to Joubert (2013), the Agricultural Sector Education and Training Authority (Agri-SETA) in 2010 identified a range of scarce skills in agriculture. At small-scale level, it was found that farmers lacked skills in a host of areas, namely farm management and entrepreneurship, resource management and record keeping, financial planning and management, marketing, processing and packaging, transport, natural resources management, and mechanical and electrical knowledge.

In the commercial sector, the critical constraint identified was the poor educational levels of a large proportion of the labour force, which demanded considerable investment in adult basic education and training and other life-skills programmes. Agri-SETA also found that commercial farmers needed to improve their management, business, and marketing skills; develop more environmentally responsible production and processing systems; raise environmental, health, and safety compliance; and make more progress towards meeting international trade standards (Joubert, 2013). Farming skills required to be improved frequently by attending relevant available trainings offered by different institutions.

Figure 5 illustrates the farming experience of the respondents over years. It is assumed that if a farmer has knowledge of a certain aspect, it will be easier to gain experience along the way (Khapayi & Celliers, 2016). Similarly, if a farmer has experience in certain aspects, then the farmer will gain knowledge from that experience. The experience can be equated to knowledge to differentiate between what is wrong and what is right.

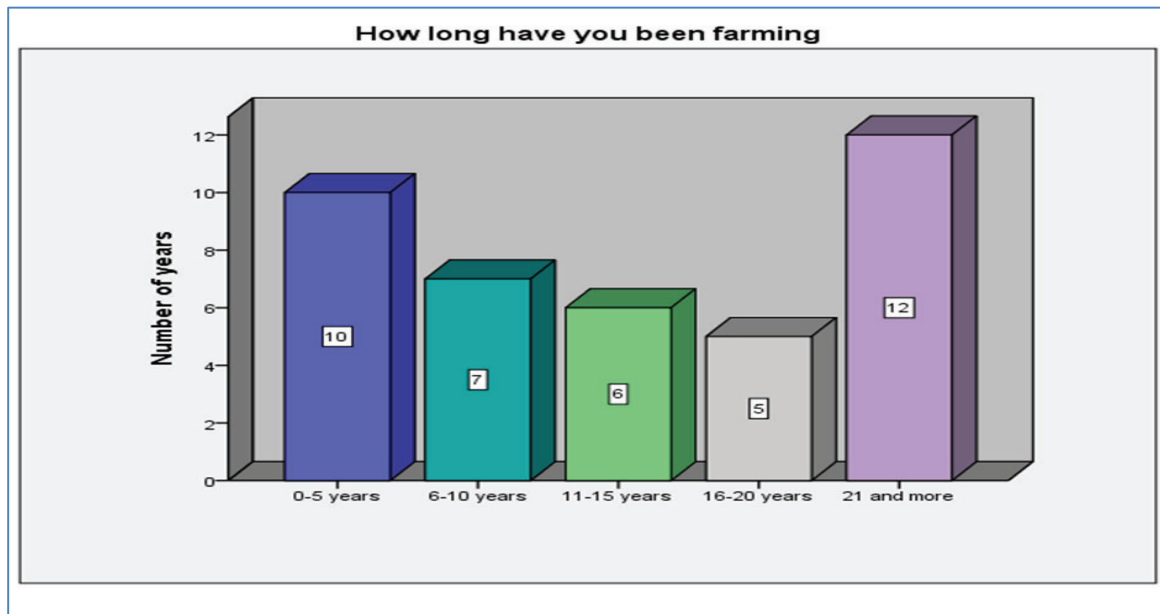


Figure 3: Farming experience of the study group

The results indicate that the farmers surveyed in the study were reasonably experienced in farming; with 17 farmers (42.5%) having 16 years and more years of farming experience and 17 (42.5%) having 10 years or less of farming experience. Six farmers (15%) had between 11 and 15 years of experience. The relationship between the respondent's experiences and their management practices will be discussed later in this chapter.

4.3.2 Health management

In animals, health may be defined as the absence of disease or the normal functioning of an organism and normal behaviour based on the observation of a certain number of individuals that determine the standard and thus health (Baker & Greer, 1980). In production sectors, health may also be defined as the state allowing the highest productivity. However, this narrow definition often is enriched by the concept of a balance between the animal and its environment, and of the animal's physical welfare. This broader definition undoubtedly is linked to changes observed in the field of veterinary medicine, which is focusing increasingly on prevention rather than cure, and which takes the animal's environment into fuller account (Gunnarson, 2004). Animal diseases may be organised schematically into three categories. Multifactorial diseases are provoked by a set of risk factors linked in particular to livestock management, with at times the participation of pathogens widespread in livestock. Known as "production diseases", multifactorial diseases are present on a large majority of livestock farms with highly variable frequencies.

The major epidemic diseases are highly contagious and impact livestock heavily (for example, foot-and-mouth disease, swine fever, highly pathogenic avian influenza); the challenge is to eradicate such diseases from a territory when possible, and their appearance in a totally susceptible population can have extensive health and economic consequences. (Ducrot *et al.*, 2011) Animal welfare issues are related closely to changes of regulations in this domain. Diseases induce suffering and pain, the absence of which is one of the criteria chosen for recently proposed animal welfare evaluation tools (Botreau *et al.*, 2007). Livestock and agro-food sectors play a central role in industrialised countries, reaching 53% of the GDP (Thornton, 2010).

Food security and safety, extensive economic activities linked to supplying the livestock sector which include the pharmaceutical industry, and the valorisation and trade of agricultural products and food that often are very technologically advanced), as in developing countries (subsistence agriculture, food security, intake of quality protein). In a report on the state of food and agriculture in the world focusing on livestock, the FAO (2011) summarised these different issues at stake as follows:

“Animal diseases, and a lack of adequate food hygiene resulting in foodborne illnesses, are a problem for everyone because they can threaten human health, disrupt markets and trade, reduce productivity and deepen poverty. Improving the management of livestock with a view to preventing and controlling disease can provide significant economic, social, and human health benefits for the poor and for society at large.”

Among the report's four key messages, it is noted that, "Livestock diseases pose systemic risks that must be addressed." The results showed that the most prevalent diseases affecting the farmers in the study area were pulpy kidney, Rift Valley fever (RVF), sheep scab, and blue udder. Fifty-two percent (52%) of the farmers vaccinated against pulpy kidney, RVF, blue tongue, and sheep scab, while 58% vaccinated against pulpy kidney, RVF, blue tongue, and blue udder, depending on the availability of funds in that period. It is evident that farmers cannot always afford vaccines, which results in lamb deaths and this indicates that government support in terms of funding to assist in buying medication is a challenge experienced by small-scale farmers.

4.3.3 Marketing skills and challenges

Table 2 illustrates that 66% of the farmers surveyed in the study in the Maluti-a-Phofung Local Municipality made sales in non-formal markets where customers came to choose from different farmers' stock in different kraals what they would like to buy, based on their affordability and preference at that time. Forty-four percent (44%) of farmers have formal markets, such as selling to abattoirs. These results indicate that access to information about marketing is one of the main management challenges that small-scale sheep production farmers encounter in the Eastern Free State.

Montshwe (2006) argued that the difficulties smallholder farmers face in accessing information about the market exposes them to serious marketing disadvantages. Due to weak public information systems, according to Mangisoni (2006), smallholders normally accept low prices for their produce when the broker informs them that their produce is of poor quality. They accept these unacceptably low prices because of poor bargaining skills and an inability to negotiate from a well-informed position. The various challenges facing smallholder farmers in accessing both local and international markets can be summarised as follows based on a survey of literature and international experience. One of the many challenges farmers face is high transport cost as it plays a vital role in marketing the farmers' livestock, because transport links the farmers to the markets or customers.

Table 1 indicates that 66% of the farmers surveyed marketed their sheep privately and 44% sold sheep to abattoirs in terms of meat production. Twenty-eight farmers surveyed indicated that they are members of Qwaqwa Wool Grower Association that shear the sheep once a year and class wool according to categories then combine it and later sell to BKB under producer number 611030A6. The other 12 farmers sell their wool privately to private buyers or middle man. The results illustrate that marketing may be a management challenge these farmers encounter in the Eastern Free State as the majority of the farmers did not market through formal marketing mechanisms in meat production. Agricultural extension can play a role in educating farmers about the benefits of being a member of Wool Grower Association to cut middle man.

Table 1: Preferred type of marketing

Preferred marketing	Percentage of respondents
Marketed their sheep privately	66%
Sold sheep to abattoirs	44%
Total	100%
Wool buyers	Number of respondents
Private buyers/ middle man	12
BKB	28
Total	40

Transport availability is crucial in the management of production systems as unreliable transport can lead to the late delivery of products (Khapayi & Celliers, 2016). Table 3 illustrate that 52% of the farmers used own transport to transport animals to the market, while 28% hired transport and 20% relied on the buyers' transport. The results illustrate that transportation to the market may be an expensive cost component small-scale sheep farmers encounter in the Eastern Free State.

Table 2: Preferred transportation to the market

Preferred transportation to market	Percentage of respondents
Own transport	52.0%
Hired transport	28.0%
Buyer's transport	20.0%
Total	100%

4.3.4 Farming equipment owned by farmers

Equipment used in agriculture is particularly significant for improving agricultural productivity since it facilitates soil cultivation, crop planting, weeding, fertilising, irrigation, and harvesting. In addition to the benefits offered by more advanced equipment, other changes in tools and work methods significantly reduce human burden and fatigue and improve farm productivity (Kumar, 2011). Education and frequent visits of extension agents to train farmers on how to use machines, and making it possible for smallholders to access and afford machines and other agricultural equipment, are important for increasing small-scale agricultural production (Owombo, Akinola, Ayodele & Koledoye, 2012).

Equally, farming equipment is essential for a sheep farmer as it is required for activities like dosing, dipping, castration, vaccination, and the treatment of sick animals, which should be carried out timeously by the farmer. Table 4 provides an indication of the availability of different types of farming equipment to the respondents.

Table 3: Essential farming equipment

Essential farming equipment	Number of respondents
Dosing gun and syringe	7 respondents (17.5%)
Dosing gun, syringe, castration equipment, and hoof shears	5 respondents (12.5%)
Dosing gun/syringe and hoof shears	3 respondents (7.5%)
Respondents that own less than two set of essential equipment (Dosing gun, syringe, castration equipment, and hoof shears)	25 respondents (62.5%)

Table 3 illustrates that only seven farmers (17.5%) had a dosing gun, hoof shear and burdisso; five (12.5%) had a dosing gun/syringe, castration equipment, and hoof shears; and three (7.5%) had a dosing gun/syringe, Aussie tag applicator and hoof shears. The remaining 25 farmers (62.5%) that own less

than two set of essential equipment (Dosing gun, syringe, castration equipment, and hoof shears) that assisted them, but they usually improvised or borrowed from other farmers. The results thus indicate that a lack of farming equipment is one of the challenges experienced by these small scale farmers.

4.4 Constraints experienced in sheep production systems by small-scale farmers

4.4.1 Reproduction and production management

The results (Table 4) indicate that mean lambing percentage for all three districts (Maluti a Phofung, Setsoto and Dihlabeng) is 91%. The Dihlabeng district had the highest lambing percentage at 104% as compared to the other two districts (Maluti a Phofung and Setsoto) with lambing percentages of 87% and 85% respectively. The results indicate that there may be possible constraints experienced in sheep production systems by small-scale farmers in some districts that result in less than 100% lambing percentage.

Table 4: Lambing percentage per location

Location	Lambing percent
All area	91%
Dihlabeng	104%
Maluti	87%
Setsoto	85%

Table 5: Fertility tests versus number of lambs born alive in the previous lambing season

Fertility tests	<50% lambs born alive
Clinical tests	50%
No action taken	40%
No fertility problem	71%

Table 5 indicates that 71% of the farmers who did not experience fertility problems previously had less than 50 lambs born alive. Approximately 40% of all farmers who took no action during the previous mating season had less than 50 lambs born alive, which is higher than the percentage of the farmers (50%) who conducted clinical tests (which included self-examination and reproductive organs

examination). It can, therefore, be concluded that the use of only clinical examinations, does not guarantee higher lambing rates. The results also indicate that reproduction and production management are some of constraints experienced in sheep production systems by small-scale farmers.

Furthermore, the farmers who performed self-examinations and clinical tests all indicated that they also identified multiple lambs with ewes that were mated, compared to less than 50% of farmers who did not take action. The results indicate that testing rams for fertility may influence the number of lambs born. Agricultural extension can play an important role in educating farmers that testing rams for fertility may influence the number of lambs born.

Figure 4 illustrates the response to the questionnaire question: “at what age are ewes mated?”

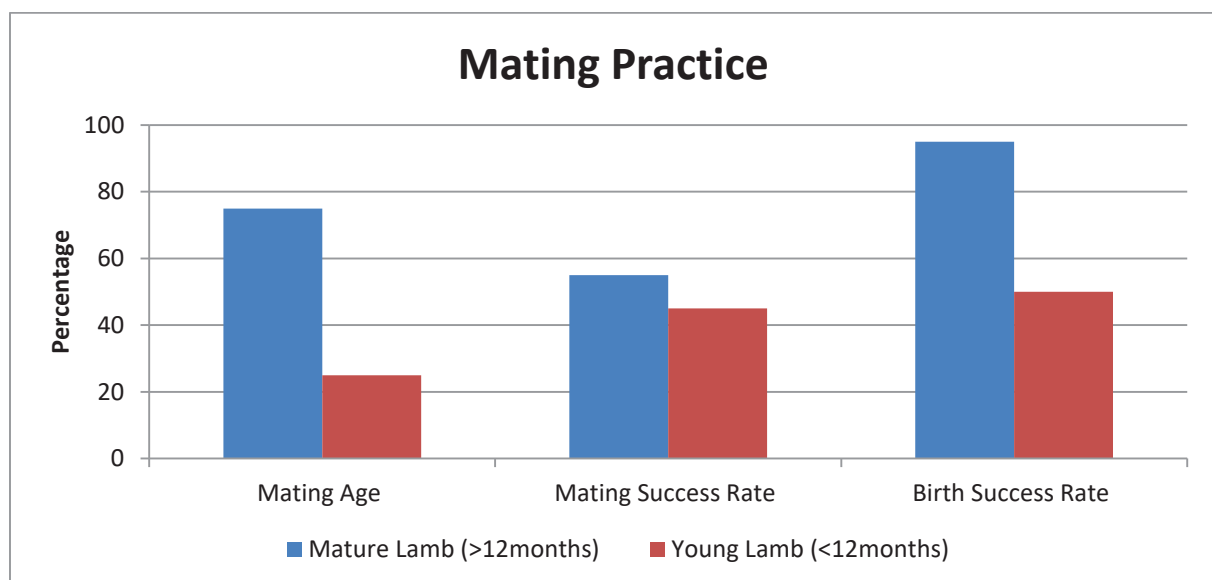


Figure 4: Mating practice

The results indicate that 75% of the farmers mated their ewes at the mature age of 12 months or more, while 25% mated their ewes at a young age. 55% of the farmers who mated their ewes at the mature age had a 95% birth rate; while 45% of farmers mated their ewes at a young age had a less than 50% birth rate.

Furthermore, the farmers who mated the ewes at a later age obtained better pregnancy rates as opposed to farmers who mated the ewes at a very early age. Mating age plays an important role in the reproduction of the ewes as this affects the number of lambs and multiple lambs born. It is apparent that most of the farmers do not have good management production systems (Khapayi & Celliers, 2016). The results indicates that mating age practice is one of the constrains experienced in sheep production systems by small-scale farmers.

Table 6 indicates that thirty farmers farmed with Merino sheep, three farmers with Dormers, two with Dorpers, and five farmers were not sure which sheep breed they farming with. The results illustrate that majority of farmer's surveyed farm with Merino breed probably because of its ability to perform better and adaptability in the study area. Agricultural extension can play important role in educating farmers about other suitable sheep breeds that can perform better in the study area

Table 6: Different sheep breeds of study group

Category		Frequency
Breed type	Dorpers	2
	Dormers	3
	Merino	30
	Unsure	5

4.4.2 Nutritional management

According to Pugh (2016), the economical and efficient production of sheep for meat, wool, show, and/or pets is contingent on proper feeding, husbandry practices, and health care. All of these are influenced by dietary intake. Maintenance of breeding animals, a high percentage of the lamb crop weaned, growth of lambs, optimal weaning weights, and a heavy fleece weight and fleece quality are important to efficiency. The nutritional requirements for maintenance, reproduction, growth, finishing, and wool production are complex because sheep are maintained under a wide variety of environmental conditions; however, attempts should be made to ensure each production unit or individual sheep has adequate nutrient intake to be healthy and productive. Table 7 provides an indication of the supplementary feeding practices of the respondents.

Table 7: Number of respondents using supplementary feeding during and after pregnancy

Number of famers using supplementary feeding two to six weeks after lambing	Type of supplementary feeds
23 farmers (57.5%) used supplementary feeding for ewes two to four weeks before and after lambing	Lucerne and salt
17 (42.5%) farmers only gave supplementary feeds after lambing for four weeks	Lucerne and salt

The results in Table 7 indicate that all the respondents provided supplementary feeding for ewes two to six weeks after lambing. However, only 23 farmers (57.5%) used supplementary feeding for ewes two to four weeks before and after lambing, while 17 (42.5%) farmers only gave supplementary feeds after

lambling for four weeks. All the farmers surveyed fed lucerne and licks as supplementary feeds to ewes that had lambed. Livestock farming under unfavourable conditions often necessitates the use of supplementary feeding as it may increase the nutrient intake of grazing ruminants and correct deficiencies in pastures (De Waal, 1990). Pugh (2016), agreed that the use of supplementary feeding results in higher lambing rates with its associated increased survival rate. This is evident in those farmers that adequately supplied supplementary feed. Supplementary feeding is thus one of the more effective methods to improve livestock production. The results indicate that it is evident that nutritional management is one of the main constraints experienced in sheep production systems by small-scale farmers.

4.4.3 Support services

Raphela (2013) argued that farmers benefit from support services such as workshops, conferences, and membership of agricultural associations. Attendance of conferences and seminars provides an opportunity for extensive sharing of information about opportunities and production possibilities that are available, and workshops must be practical and relevant to the challenges they face rather than being too theoretical.

Agricultural information usually reaches rural farmers via extension workers, community libraries, radio, television, films, agricultural pamphlets, and state and local government agricultural agencies (Nnenna & Obadike, 2011). Respondents were requested to provide information of the sources of information used and types of support received of which is summarised in Table 8.

Table 8: Source of information and support

Source of information and support	Frequency	Accumulative Percentage (%)
DoA	18	45.0
Agents connected to a cooperative	4	55.0
Agricultural magazines	4	65.0
Stud consultant	4	75.0
DoA / Agents connected to cooperative	2	80.0
DoA / Agricultural magazines	3	87.5
Agents / Stud consultant	2	92.5
DoA / Agents / Agricultural magazines	2	97.5
All	1	100.0
Total	40	-

Table 8 indicates that 45% of the respondents considered the Department of Agriculture (DoA) as the most important source of information for sheep farming. The results indicate that inadequate support services from government is one of constraints experienced in sheep production systems by small-scale farmers. Agents connected to cooperatives, agricultural magazines, and breed consultants were rated as the second most important sources of information with 55%, 65%, and 75% respectively. Agricultural extension can play a role in increasing methods to access of information for support services.

5. Conclusion

The emergent agricultural sector in South Africa has the potential to contribute to the growth of rural areas, and the reduction of unemployment, poverty, and inequalities. The potential of emerging farmers to participate in this sector is, however, untapped. Small-scale farmers do not participate in markets that yield high returns. In order for small-scale farmers to contribute to rural development, the abovementioned aspects need to be addressed effectively. The study identified seven specific challenges for small-scale farmers in the area. These were low education levels and a lack of farming skills pertaining to livestock production; poor management skills in terms of nutritional and health management; high transportation costs; lack of market information; and poor delivery of support services from the government.

The majority of the products produced by the farmers is sold to informal markets where they receive poor prices. Some of the farmers used more than one marketing channel. The distance to markets is an important factor as long distances to the market can be discouraging to farmers in terms of transportation costs.

The findings also showed that most respondents suffered from a lack of market information owing to a lack of communication, tools, and support services from the government and extension officers. The majority of the farmers relied on word of mouth, family, and own research for information regarding product prices, which in most cases was biased, inaccurate, and/or outdated. Marketing information is very important for the market participation of small-scale farmers. The availability of market information with regard to product prices can help farmers make informed decisions about the marketing channels in which they participate. Farmers with no access to market information often make poor decisions.

Agricultural production methods in particular are dynamic and require farmers to have access to information and being able to interpret information. When people are uneducated, they may become victims of being cheated and once people are cheated, they may refuse to adopt further innovations or change even if it benefits them. The majority of the farmers in the present study had low levels of education and skills.

6. Recommendations

Many limiting factors that affect Eastern Free State small-scale farmers' management of sheep production systems were discussed in this paper. The main factors were the farmers' low educational levels that affect their comprehension of the dynamics of agriculture, poor management, lack of farming skills, high transportation costs to formal markets, poor market information, and insufficient support services from the government, and a lack of farming equipment. The latter was evident as 50% of the farmers did not possess the most basic farming equipment and therefore the most basic activities could not be carried out. The DoA needs to take a leading role in investing in these support services, access to productive land, production inputs, extension services, and value-adding facilities to stimulate the farmers' participation in remunerative agricultural markets. Finally, the study recommends that the government must host planned workshops for all farmers in order to equip them with knowledge. Some agricultural bodies, such as the RPO, NWGA, and breeders' societies, can play a meaningful role in the training of these farmers.

7. Extension implications

It is evident that there is a gap in the technical knowledge of small-scale farmers. The extension officers are particularly well positioned and they can play a significant role in conveying the outcomes of this study to small-scale farmers. It is obvious from the study that frequent intensive educational programmes are required to assist farmers in decreasing and closing the gaps identified in the study.

Farmers should be trained to understand their product in terms of aspects that significantly affect price. These include, among others, the animals' weight, condition (grading), age, and microns of the wool at the marketing stage. The DoA needs to consider support policies and regulations to stimulate growth among farmers. The market participation of emerging farmers must be improved through encouraging group marketing, the upgrading of roads to enable easy access to markets, and livestock auctioneers should be motivated by means of an incentive system to conduct auctions in the rural areas. Extension officers and farmers can be empowered by attending workshops as well as agricultural shows (NAMPO), forming group discussions, and taking short courses that are offered by universities.

7. Acknowledgement

Financial assistance from the Central University of Technology, Free State, is gratefully acknowledged.

8. References

AINA, L.O. 2007. *Globalisation and Small-scale Farming in Africa: What Role for Information Centres?* World Libraries and Information Congress, 73rd IFLA General Conference and Council.

Durban, South Africa Development, on behalf of the Presidency. Pretoria: Government of the Republic of South Africa.

ALIBER, M. and HALL, R. 2010a. *Development of Evidence-based Policy around Small-scale Farming*. Report commissioned by the Programme to Support Pro-poor Policy (PSPPD). Pretoria: The Presidency.

BAKER, J.K. & GREER, W.J. 1980. *Animal Health: A Layman's Guide to Disease Control*. Danville, Illinois: Interstates Printers and Publishers.

DE WAAL, H.O. 1990. Animal production from native pasture (veld) in the Free State region – A perspective of the grazing ruminant. *South African Journal of Animal Science*, 20 (1): pp. 1-9.

FOOD AND AGRICULTURE ORGANIZATION (FAO). 2011. *World Livestock 2011: Livestock in Food Security*. Rome: FAO.

JOUBERT, R. 2013. The skills needed to make SA farming more profitable. *Farmers Weekly*, 16 August. Available at: <https://www.farmersweekly.co.za/agri-business/agribusinesses/the-skills-needed-to-make-sa-farming-more-profitable/>

KHAPAYI, M.I. and CELLIERS, P.R. 2016. Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. *South African Journal of Agricultural Extension*, 44 (1): pp. 25-41.

KREUTER, U.P. & WORKMAN, J.P. 1997. Comparative profitability of cattle and wildlife ranches in semi-arid Zimbabwe. *Journal of Arid Environments* 35: 171-187.

LOUW, A., CHIKAZUNGA, D., JORDAN, J. and BIENABE, E. 2007. *Regoverning Markets: Small-scale Producers in Modern Agrifood Markets. Agrifood Sector Series: Restructuring Food Markets in South Africa: Dynamics within the Context of the Tomato Sub-sector*. Pretoria: University of Pretoria.

MAKAPELA, J. 2009. An overview of the management practices for wool production amongst the communal farmers of the HEWU district in the Eastern Cape Province. M.Tech thesis. Nelson Mandela Metropolitan University, Port Elizabeth.

NORDBLOM, J.L. and SHOMO, F. 1995. *Food and Feed Prospects to 2020 in the West Asia/North Africa Region*. ICARDA Social Science Paper No. 2. Aleppo, Syria: International Centre for Agricultural Research in the Dry Areas.

NNENNA, A. and OBADIKE, A. 2011. Rural farmers' problems accessing agricultural information: A Case study of Nsukka Local Government Area of Enugu State, Nigeria. *Library Philosophy and Practice*, 20 (1): pp. 40-43.

PUGH, D.G. 2016. *Overview of Nutrition: Sheep*. Alabama: Department of Pathobiology, College of Veterinary Medicine, Auburn University. [Online]. Available at:

<http://www.msdivetmanual.com/management-and-nutrition/nutrition-sheep/overview-of-nutrition-sheep>

RANDELA, R. 2005. Integration of Emerging Cotton Farmers into the Commercial Agricultural Economy. Doctoral dissertation. University of the Free State, Bloemfontein, South Africa.

SAS INSTITUTE INC. 2012. *The Statistical Procedure Manual*. North Carolina: SAS Institute Inc.

STATISTICS SOUTH AFRICA, 2011. *Census 2010*. Pretoria: Stats SA.

SALAMI, A., KAMARA, A.B. & BRIXIOVA, Z. 2010. *Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities*. Working Paper Series. Tunis: African Development Bank.

SMET, M. & WARD, D. 2006. Soil quality gradients around water points under different management systems in a semi-arid savannah, South Africa. *Journal of Arid Environments* 64: 251-269.

VAN NIEKERK, P.D.P. and TRUCKMAN, N. 2002. Product Development as Part of a Positioning Strategy for the Hunting Industry in the Eastern Cape. D-Tech thesis. Port Elizabeth Technikon, Port Elizabeth.

VAN SCHALKWYK, H.D., GROENEWALD, J.A., FRASER, G.C.G., OBI, A. & VAN TILBURG, A. 2012. *Unlocking Markets to Smallholders: Lessons from South Africa*. Mansholt Publication Series No. 10. The Netherlands: Mansholt Publications.